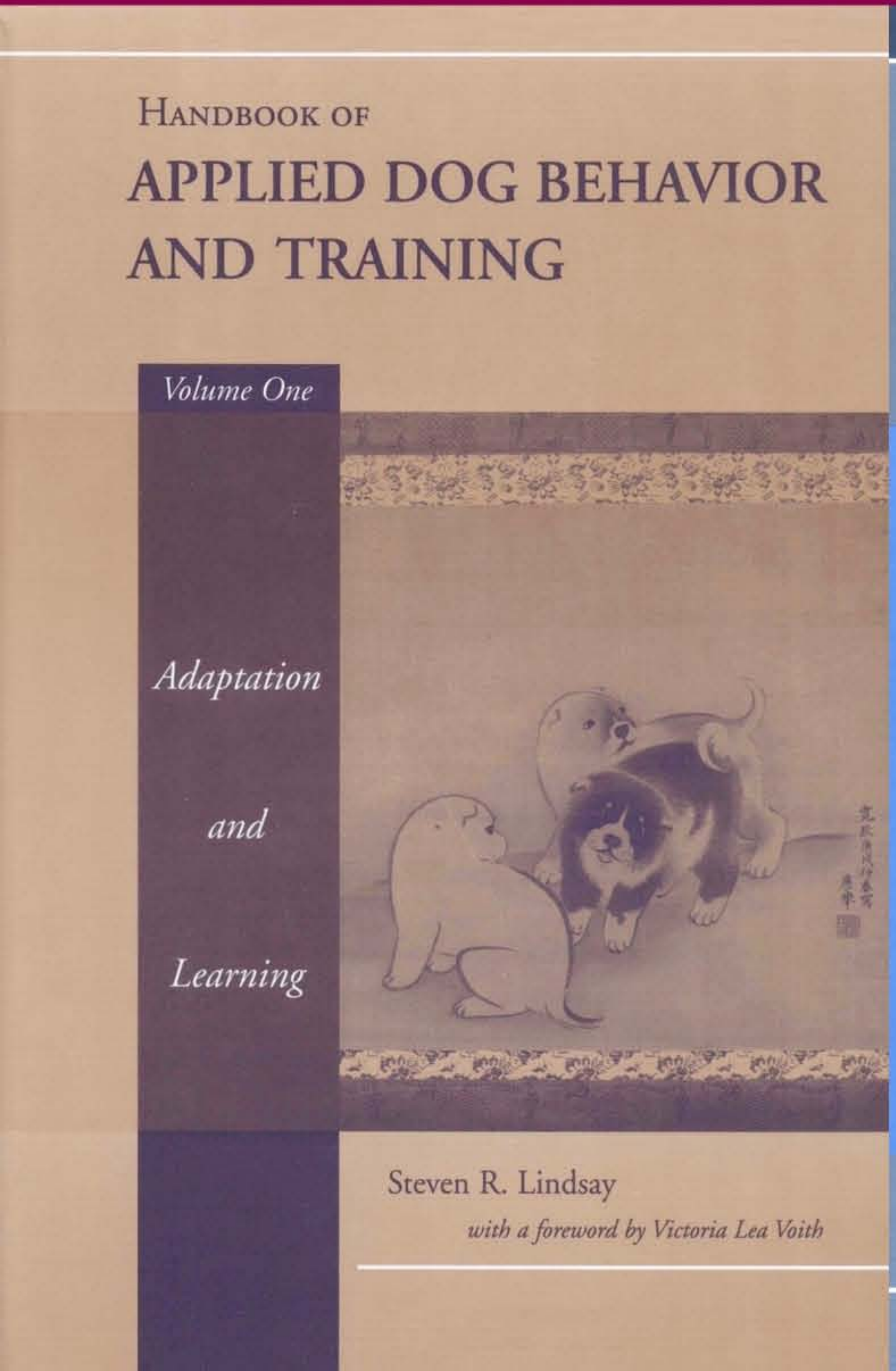
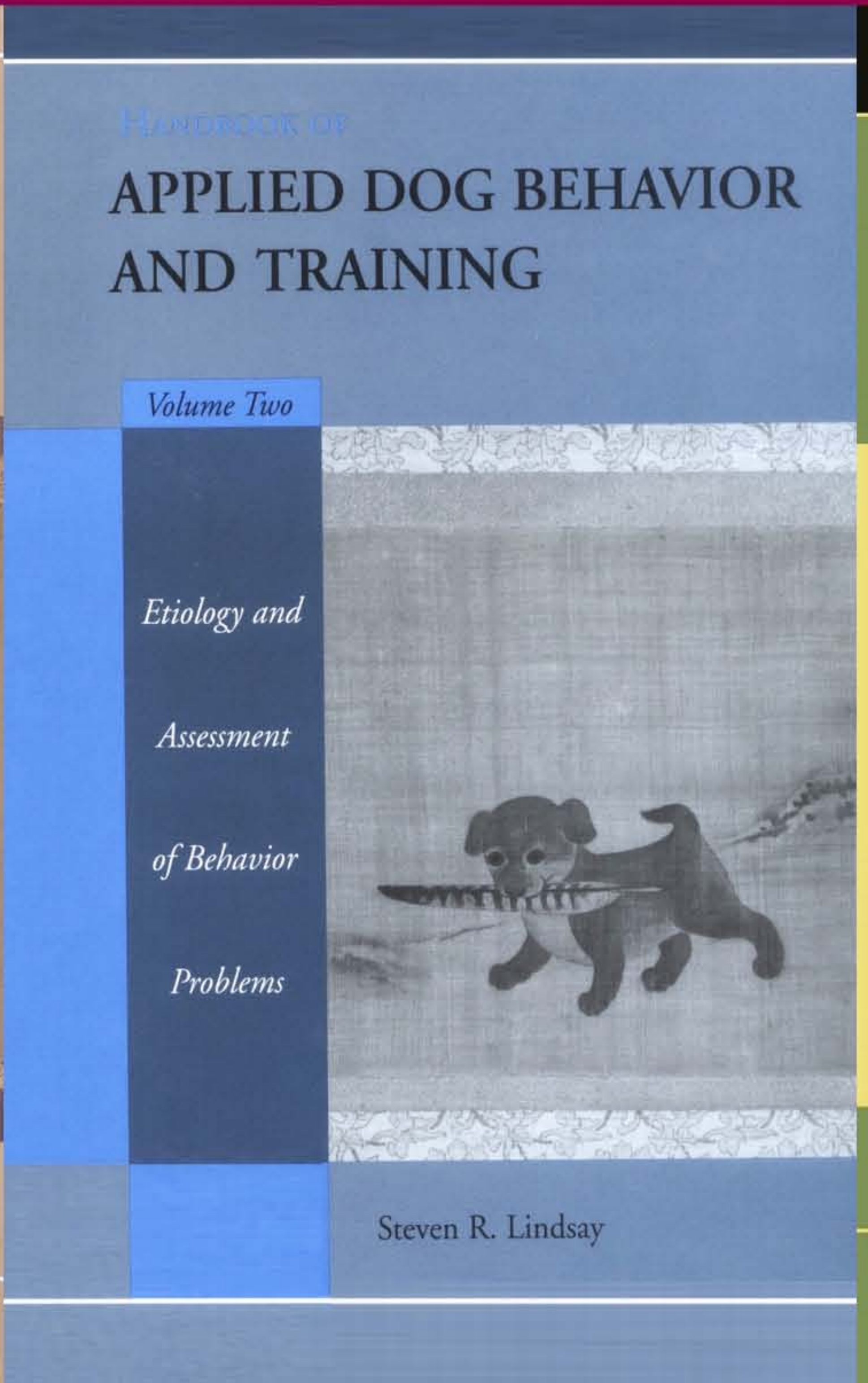
Handbook of Applied Dog Behavior and Training

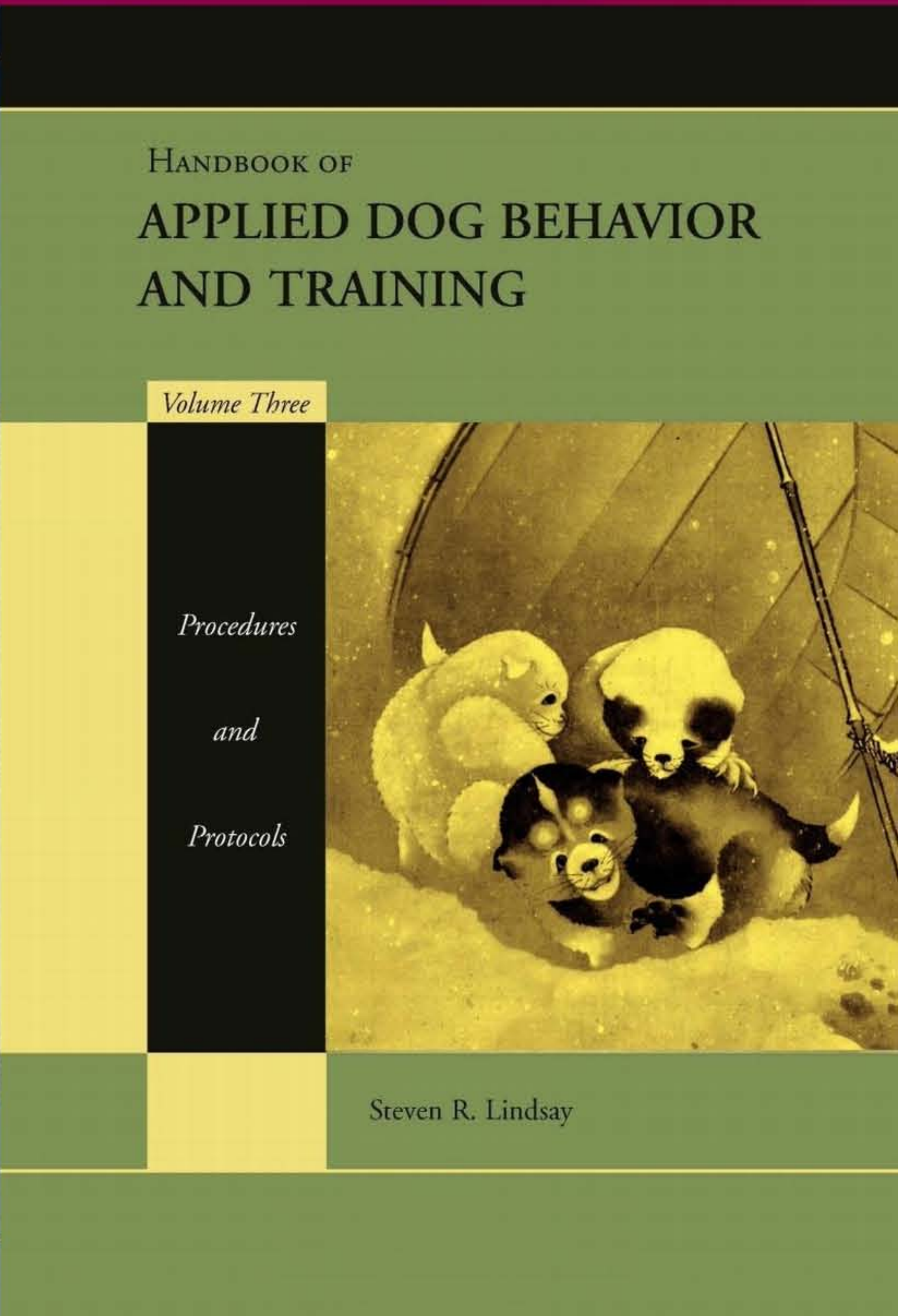
Volume 1
Adaptation and Learning

Volume 2
Etiology and Assessment of Behavior Problems

Volume 3
Procedures and Protocols







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Volume One

Adaptation

and

Learning

Steven R. Lindsay

with a foreword by Victoria Lea Voith

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Steven R. Lindsay, MA, is a dog behavior consultant and trainer who lives in Philadelphia, Pennsylvania, where he provides a variety of behavioral training and counseling services. In addition to his long career in working with companion dogs, he previously evaluated and trained highly skilled military working dogs as a member of the U.S. Army Biosensor Research Team (Superdog Program). Mr. Lindsay also conducts workshops and is the author of numerous publications on dog behavior and training.

Cover design by Justin Eccles
Text design by Dennis Anderson

Blackwell Publishing Professional
2121 State Avenue, Ames, Iowa 50014
Orders: 1-800-862-6657
Office: 1-515-292-0140
Fax: 1-515-292-3348
Web site: www.blackwellprofessional.com

Cover image: “Three Puppies,” 1790 by Okyo Maruyama. Courtesy of the Philadelphia Museum of Art.

Printed on acid-free paper in the United States of America
First edition, 2000

Library of Congress Cataloging-in-Publication Data

Lindsay, Steven R.
Handbook of applied dog behavior and training / Steven R. Lindsay; foreword by Victoria Lea Voith.—1st ed.
p. cm.
Contents: v. 1. Adaptation and learning.
ISBN-13: 978-0-8138-0754-6
ISBN-10: 0-8138-0754-9
1. Dogs—Behavior. 2. Dogs—Training. I. Title.

SF433.L56 1999
636.7′0887—dc21 99-052013

The last digit is the print number: 9 8 7 6

Dedicated with affection

and respect to my dog,

Yuki,

whose gentle and sincere

ways have revealed the virtues

of the human-dog bond in

ways that words alone will

forever fail to express.

Contents

Foreword

THIS IS A monumental work arising from the love of dogs and the pursuit of knowledge. Cynophiles, academics, animal behaviorists (with and without institutional degrees), literate dog owners, and anyone who has ever wanted to know something specific or just plain more about dogs are indebted to Steve Lindsay for this labor of love.

This treatise is an encyclopedia about dogs: in-depth reviews and interpretations of the literature pertaining to the dog's history, physiology, behavior, and interactions with people, and explanations and evaluations of training procedures, management strategies, and problem-solving techniques. This book is not limited to a review of the literature about dogs but also discusses basic scientific disciplines and discoveries with other species that pertain to understanding dogs. It is obvious that Steve Lindsay has thoroughly read and analyzed every publication he has referenced—an increasing rarity in today's press. The summaries of research papers or theoretical discussions will suffice for some readers, but others will be compelled to obtain the original works and read them.

Very practical and important aspects of this book are Steve Lindsay's training, treatment, and management strategies regarding dog behavior. Steve's broad experiences in the dog world have enabled him to integrate valuable components of a variety of training and management procedures. The techniques are explained very thoroughly and in sufficient detail that an educated person should be able to understand and implement them. His approaches are designed to achieve a satisfying human-dog relationship from the perspective of both species.

This handbook will help dog owners and many, many canine behavior consultants/counselors and trainers. It will also stimulate further discussion, observation, research, and analyses, ultimately leading to more knowledge about dog behavior and human-dog interactions. I consider it the most valuable publication about dogs since Scott and Fuller's classic text *Genetics and the Social Behavior of the Dog,* published in 1965.

VICTORIA LEA VOITH, DVM, PHD

Charter Diplomate of the American College of Veterinary Behaviorists
President, American Veterinary Society of Animal Behavior

Acknowledgments

MANY PEOPLE deserve acknowledgment for their contributions, but none more so than the dog owners who have given me the privilege and responsibility of helping them to train their dogs or to assist them in resolving a behavior problem. I feel a special debt of gratitude to William Carr, Scott Line, and Victoria Voith. Dr. Carr graciously gave freely of his time to read and discuss the entire manuscript. His knowledge and expertise helped to clarify a number of important areas of relevant research, especially developments in comparative psychology and the study of olfaction. Dr. Line reviewed the entire text and provided useful suggestions for its improvement. Dr. Voith has been a source of sustained encouragement for the project since its inception, giving me valuable guidance and advice. A special thank you is due to Christina Cole for her unselfish help and support. I am grateful to John Flukas, whose editorial advice has been consistently constructive and helpful. Finally, I thank Gretchen Van Houten and the great staff at Iowa State University Press for their assistance and patience in preparing the manuscript for publication.

Introduction

Before you can study an animal, you must first love it.

KONRAD LORENZ (Fox, 1998)

THE DOG has occupied an enduring place in our cultural heritage as an icon of interspecies cooperation and faithfulness. Speculation about the origins of this unique relationship continues to inspire lively debate and discussion, but nothing definitive can yet be said about the motivations guiding the first dog keepers to capture and tame wild or semidomesticated canids as companions and helpers. Even less can be said about the various functions these protodogs served or the methods used by our ancestors to train them. What is known suggests that the dog's domestication was not the result of a conscious effort or stroke of genius, but rather the outcome of a slow evolutionary process over many thousands of years. The gradual biological transformation of the wolf into the domestic dog appears to have culminated in the development of close social interaction between humans and dogs sometime during the Stone Age. What form this relationship took 14,000 years ago is not known, but it is likely that some practical implications of dogs were recognized and exploited by ancient hunter-gatherers. Most of the potential utilitarian benefits arising from domestication would have been of little use, though, if it had not been for the simultaneous development of the methods needed for managing and controlling dog behavior. The obvious necessity of behavioral control for early humans in their various dealings with dogs led the naturalist G. L. Buffon to write in the 18th century, "The training of the dog seems to have been the first art invented by man, and the fruit of that art was the conquest and peaceable possession of the earth" (quoted in Jackson, 1997).

Buffon's suggestion that dog training was "the first art invented by man" suffers from a lack of empirical evidence. Nonetheless, it is reasonable to believe that the practice of controlling and modifying dog behavior to serve human purposes springs from very ancient roots that antedate the rise of civilization. Early human association with animals as natural competitors and beasts of prey offered ample opportunity born of strife and necessity to develop an appreciation of animal habits and various methods for controlling animal behavior. Such information transmitted from generation to generation would have provided a viable cultural tradition of animal lore for the development of dog training as an art of considerable sophistication. From an early date, dogs have performed many services, such as assisting human hunters in the pursuit of game, giving alarm to the presence of intruders, pulling sledge or travois, providing warmth and comfort, as well as offering playful distraction for children. Practical uses aside, even the most casual interaction between humans and dogs would have demanded a rudimentary understanding of dog behavior and the ability to control it. Both biological changes (nature) and cultural transmission (nurture) combined to forge the primal human-dog bond—an epigenetic process that is reenacted in the life of every companion dog.

Despite the ubiquitous distribution of dogs throughout the ancient world, historical records describing their early use, breeding, and training are relatively rare and incomplete. A few ancient authors wrote at length on the subject of dog behavior, training, and management, but, for the most part, many

important details about the specific methods used by ancient trainers to modify dog behavior are left to the reader's imagination. The writings of Xenophon are of particular value in this respect, but even the patron philosopher of dog and horse training provides only scant and scattered information about how dogs were trained in the distant past. Although occasional departures from this pattern can be found, very few authors took up the subject of dog behavior and training as a serious area of study, at least until fairly recent times. A turning point away from this general neglect occurred with the appearance of Darwin's *The Expression of the Emotions in Man and Animals.* Darwin's evolutionary theories and careful descriptions of dog behavior exerted a profound influence on naturalists sympathetic to his ideas, encouraging them to pay attention to dog behavior as a way to understand better the origins of human conduct. These developments played an instrumental role in the advancement of psychology and paved the way for a wider scientific and popular interest in dog behavior.

The scientific study of dog behavior and psychology was placed on an experimental foundation by the Russian physiologist Ivan Pavlov. Pavlov and his many associates crafted various experimental methods for studying associative learning processes in dogs. The result of this revolutionary research was a collection of detailed and exhaustive analyses of the functional relations controlling the acquisition and extinction of conditioned reflexive behavior. Following in the wake of Pavlov's discoveries, subsequent developments in the science of behavior and learning theory were extremely energetic and enthusiastic, with many thousands of studies being carried out and their findings published over the ensuing decades. In America, around the same time that Pavlov was making his mark on the history of psychology in Russia, Edward Thorndike was conducting a systematic study of voluntary or instrumental behavior at Columbia University. His detailed observations on how animals learn to escape from various puzzle boxes through trial and error (or, as he might prefer, "trial and success") established the study of instrumental behavior. Together, Pavlov and Thorndike formed the intellectual and methodological foundations for the experimental study of animal behavior and learning. Most behavioral research in the 20th century can be traced back to the pioneering work of these two experimentalists.

Darwin's evolutionary approach to the investigation of animal behavior was embraced by another group of scientists, mainly composed of Europeans, who emphasized the importance of direct observation of species-typical behavior occurring under natural conditions. Their efforts set the foundations for the development of ethology. In America, comparative (animal) psychologists, who, like their European counterparts, were also interested in the evolutionary continuity of behavior across species, also took up the Darwinian banner. Unlike the early ethologists, however, comparative psychologists stressed the need for experimental methodology, thus limiting their research to a few species (mainly primates, rodents, and birds) housed under laboratory conditions.

These combined scientific efforts have produced an authoritative body of knowledge about animal behavior. Much of this information is highly specialized, sometimes difficult to access, and often only available as isolated research reports. Consequently, an important purpose for writing this book has been to draw upon these various trends in order to establish a foundation of principles and methods for understanding and managing dog behavior. The material reviewed for this purpose has been selected based on two general criteria: scientific validity and relevance for the practical management of dog behavior. In surveying the literature, I have made a conscientious effort to review the original materials. It became apparent early on that many reports and secondary texts had been either inappropriately interpreted or generalized beyond what is justifiable by the available data. I have done my best to avoid such pitfalls and to correct errors of the past where appropriate. The topics covered in *Volume One* include origins and evolution, ontogeny, neurobiology, senses, biological constraints, classical conditioning, instrumental learning, aversive control, and behavioral pathology. A concluding chapter examines

the human-dog relationship, including its cultural and psychological significance. *Volume 2* (in press) covers the etiology and assessment of behavior problems, aggression, fear and phobias, separation distress, hyperactivity, compulsive behavior, destructive behavior, and social excesses.

Many of the experiments described in the following chapters were performed at a huge cost of suffering for scores of laboratory animals, including thousands of dogs, experimented upon for the sake of scientific curiosity and the advancement of our collective knowledge. It is heartening to know that, over the past decade or so, many reforms (often led by experimental scientists themselves) have taken place with respect to the way experimental animals are treated and housed. These regulatory changes would make many historically important studies very difficult or impossible to perform under the current standards of laboratory animal care and welfare. However, to ignore this significant body of scientific literature because of the suffering it has brought to laboratory animals would be tantamount to a double injury. It seems fitting that such knowledge should be applied whenever possible for the benefit of those animals whose sacrifice made it possible. Morally speaking, there are no good or bad scientific facts, but there are good and bad ways in which experiments are performed and scientific knowledge applied for practical purposes.

Finally, dog behavior problems represent a serious welfare concern. Currently, the vast majority of dog behavior services are performed by dog trainers, with a handful of veterinary and applied animal behavior consultants providing regional counseling services through veterinary schools and private animal behavior practices spread out thinly across the country. It is difficult to pin down exactly how professional services are divided between these groups, but a recent survey by the American Veterinary Medical Association (1997) suggests that a relatively small number of companion animals are referred for behavioral counseling. The report estimates that less than one-half of 1% of dog owners in the United States utilized veterinary behavioral counseling services in 1996. This is a somewhat surprising and puzzling statistic, considering that some authorities suggest that behavior problems represent a leading cause of euthanasia, causing the death of more dogs each year than die as the result of infectious disease, metabolic conditions, and cancer combined. Although this estimate appears to be inflated (see *When the Bond Fails* in Chapter 10), dog behavior problems do, undoubtedly, represent a significant source of distress and death for dogs. Obviously, cooperation between all applied animal behavior professionals is required in order to service the behavioral needs of the dog-owning public most efficiently and effectively. Animal behavior counseling, dog training, and veterinary behavioral medicine bring a variety of specific contributions and unique strengths to the practical control of dog behavior and the management of dog behavior problems. Recently, leadership from these various professional groups made the first tentative steps toward constructive collaboration by establishing various educational programs, sponsoring interdisciplinary forums, and organizing other mutually beneficial ventures. Unfortunately, however, practitioners from these various disciplines are not always familiar with the specialized knowledge and skills utilized by others working outside of their immediate domain or not sharing their academic and practical background. It is my sincere hope that this book will play a constructive role in ameliorating this situation by bridging some of these gaps and contributing to the process of professional and educational reform of dog training and behavioral counseling.

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1

Origins and Domestication

For thousands of years man has been virtually, though unconsciously, performing what evolutionists may regard as a gigantic experiment upon the potency of individual experience accumulated by heredity; and now there stands before us this most wonderful monument of his labours—the culmination of his experiment in the transformed psychology of the dog.

GEORGE ROMANES, *Animal Intelligence* (1888)

UNDERSTANDING THE dog's behavior and appreciating its unique status as "man's best friend" is not possible without studying its evolution and domestication. From ancient times onward, numerous species have undergone pronounced biological and behavioral changes as the result of domestication. The purposes guiding these efforts are as diverse as the species involved. Utilitarian interests such as the procurement of food, security, and other valuable resources or services derived from the animal were surely important incentives, but utilitarian motives alone are not enough to explain the whole picture, especially when considering the domestication of the dog.

Many theories have been advanced to explain how the progenitor of the dog was originally tamed and brought under the yoke of captivity and domestication. These theories often include colorful portraits of primitive life, motives, and purposes that rely on a number of questionable and unprovable assumptions about prehistoric existence (Morey, 1994). For example, one popular view suggests that humans may possess an ageless and universal (innate?) urge to keep animals as pets. Although this theory has some attractive features, it is difficult to defend scientifically. Certainly, dogs share an intimate place in Western society and are often treated with affectionate care in many modern primitive cultures as well (Serpell, 1986/1996); nonetheless, one cannot exclude the possibility that this so-called "affectionate" motive is a rather late cultural development. Further, although it is true that keeping pets as attachment objects is common around the world today, one cannot jump from this observation to the conclusion that a similar set of motives guided ancient people

to capture and domesticate wild animals. Attitudes about animals and, in particular, dogs appear to be guided by beliefs and customs that are to a considerable extent conditioned and dependent on cultural, economic, and geographical circumstances (see Chapter 10).

Undoubtedly, a dog's life during the early stages of domestication was very different than it is today. Over the centuries, the dog's functions have evolved and changed, sometimes dramatically, depending on the assertion or absence of relevant cultural and survival pressures. In times of scarcity and need, the defining motive for keeping dogs was probably dominated by utilitarian interests; whereas, during times of abundance and well-being, dogs could be readily transformed into convenient objects for affection, comfort, or entertainment.

Archeological Record

Despite the difficulties, discovering when and how this enduring relationship first appeared are questions of tremendous scientific interest and importance. Authorities differ with respect to the exact historical moment or time frame, but many prehistoric sites show that a close association between humans and dogs has existed continuously for many thousands of years. Although a loose symbiotic mutualism probably existed long beforehand, the earliest archeological evidence of a "true" domestic dog is dated to 14,000 years before the present (BP). The artifact (a mandible) was unearthed from a Paleolithic grave site at Oberkassel in Germany (Nobis, 1979, in Clutton-Brock and Jewell, 1993). Protsch and Berger (1973) have collected and carbon dated canine skeletal remains taken at various sites around the world, showing great antiquity and geographical dispersion: Star Carr (Yorkshire, England), 9500 BP; Argissa-Magula (Thessaly), 9000 BP; Hacilar (Turkey), 9000 BP; Sarab (Iran), 8900 BP; and Jericho, 8800 BP. One of the most famous of these archeological finds is a Natufian skeleton of an old human (sex unknown) and a puppy buried together some 12,000 years ago at Ein Mallaha in Israel (Davis and Valla, 1978). The human's hand is positioned over the chest of the 4- or 5-month-old puppy (Fig. 1.1). One is moved by the ostensible intimacy of the two species buried together, and even tempted to ascribe a feeling of "tenderness" to the embrace binding the person and puppy together over the centuries.

The earliest remains of a domestic dog in North America were found at the Jaguar Cave site in the Beaverhead Mountains of Idaho. These bones had been previously dated from 10,400 to 11,500 BP, but radiocarbon dating of some of the artifacts revealed that they are "intrusions" of a much more recent origin, with a probable age not exceeding 3000 years (Clutton-Brock and Jewell,
1993).

Domestication: Processes and Definitions

Robert Wayne and his associates at UCLA have performed a molecular genetic analysis of the evolution of dogs and wolves, suggest-

Fig. 1.1. A Natufian burial site at Ein Mallaha in northern Israel shows a human skeleton in what appears to be an "eternal embrace" with the skeletal remains of a puppy located in the upper right-hand corner. From Davis and Valla (1978), reprinted with permission.

ing that efforts to domesticate dogs may have taken place much earlier than indicated by the archeological record, putting the dog's origins back 100,000 years or more (Vila et al., 1997). The researchers argue that these more ancient efforts to domesticate dogs may have occurred without producing significant morphological change in the protodog, thus explaining the absence of dog skeletal artifacts appearing before 14,000 years ago:

> To explain the discrepancy in dates, we hypothesize that early domestic dogs may not have been morphologically distinct from their wild relatives. Conceivably, the change around 10,000 to 15,000 years ago from nomadic hunter-gather societies to more sedentary agricultural population centers may have imposed new selective regimes on dogs that resulted in marked phenotypic divergence from wild wolves. (1997:1689)

Although no physical evidence of domestic dogs living with humans before 15,000 years ago exists, skeletal remains of wolves have been found in association with hominid encampments in China (the Zhoukoudian site) from 200,000 to 500,000 years ago (Olsen, 1985).

Although contested in the past, the biological ancestry of the dog is now certain. On the basis of both genetic and behavioral studies the dog is a domestic wolf. However, considerable debate still surrounds the identity of the closest relative among wolf subspecies. Zeuner (1963) has argued that the most likely lupine progenitor is *Canis lupus pallipes* (the Indian wolf), a small Eastern variety. He bases this assumption on both behavioral and morphological considerations. The smaller Indian wolf would have been less of a threat to human encampments and would have been more readily tolerated than the larger and more aggressive northern varieties.

Olsen and Olsen (1977) have selected the Chinese wolf (*Canis lupus chanco*) as the most likely canid progenitor. They base their choice on this wolf's small size and mandible morphology, noting that the apex of the coronoid process (the uppermost part of the jaw) turns back in both the Chinese wolf and the domestic dog but not in the jaw bone of other wolf species (Fig. 1.2). Clutton-Brock

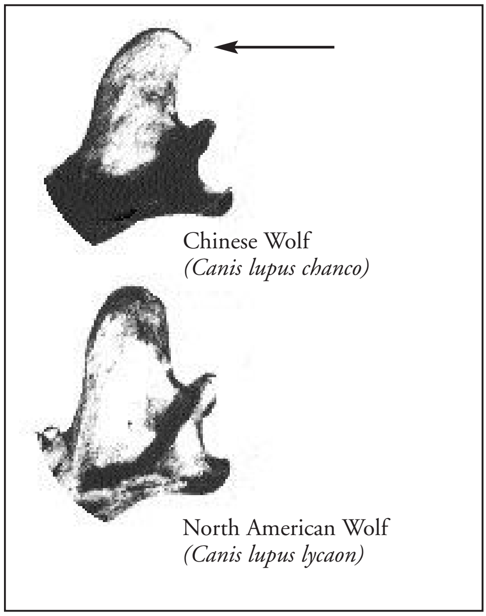

FIG. 1.2. Note how the apex of the coronoid process (see arrow) tends to turn back. This feature is not apparent in other subspecies of wolves, coyotes, or jackals. It is a common anatomical feature found in dogs, however, suggesting that the Chinese wolf may have played an important role in the ancient domestication of the dog. From Olsen and Olsen (1977), The Chinese wolf, ancestor of New World dogs, *Science* 197: 533–535, reprinted with permission.

(1984) has identified *Canis lupus arabs* (a western Asiatic wolf) and the European wolf as the most likely ancestors of most modern European breeds, with *Canis lupus lupus* having a greater representation in the genome of Arctic and European spitz-type breeds. It is conceivable that the proliferation of domestic dogs has been genetically influenced by several wolf subspecies at different times and places, or owes its genetic past to a wolf species that is no longer existent (Fig. 1.3).

Interspecific Cooperation: Mutualism

By the end of the last glacial period, early humans' migratory activities overlapped the hunting range of competing predators, especially wolves. As nomadic people came into contact with wolves, some members of the

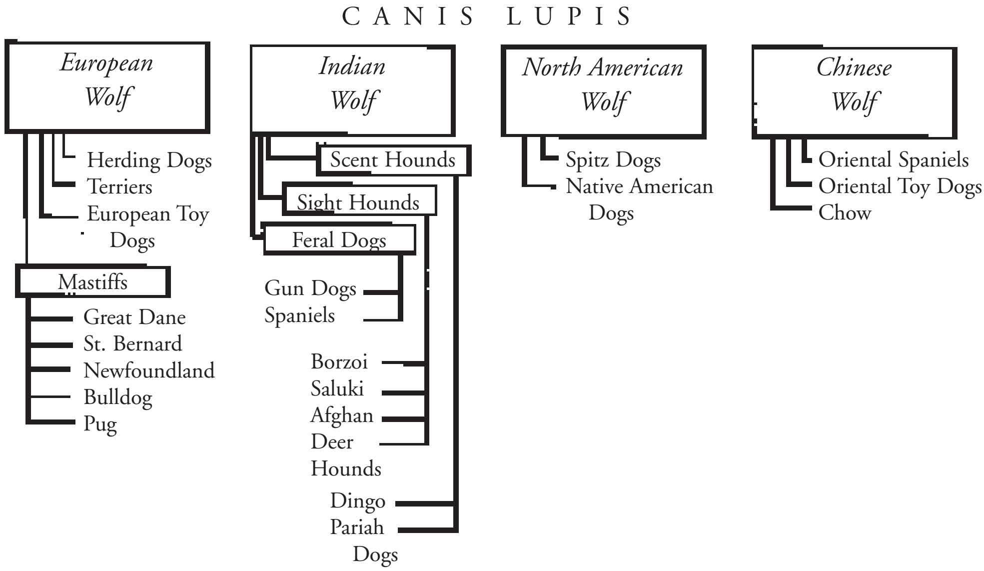

FIG. 1.3. Various subspecies of the wolf are believed to have contributed to the genome of the domestic dog. According to one theory, the dog was independently domesticated in various parts of the world, with no single site of origin. Although grouped as though from discrete origins, the breeds included here have probably undergone considerable crossbreeding over their long history of development. After Clutton-Brock and Jewell (1993).

wolf population may have been confident enough to follow closely behind these migrant hunting and gathering groups. By staying nearby, the ever-opportunistic wolves could have easily tracked animals wounded by hunters, thus securing an easy meal for themselves at least until the advancing hunting party arrived at the scene. Also, by retreating and lingering at a safe distance, wolves could scavenge on the slaughtered remains left behind (Zeuner, 1963). Juliet Clutton-Brock (1984, 1996) has speculated that such a hunting partnership may have played an important role in the development and spread of the bow and arrow as a hunting tool during the Mesolithic period, arguing that wolves or protodogs may have provided a significant advantage to early hunters by tracking and subduing large animals wounded by arrows fitted with sharp stone heads called microliths. Besides forming an effective hunting partnership, wolf-pack territories may have formed around human camps, thus providing a natural protective shield against the threat of predation by other less friendly wolves and competing human groups. Possibly, from this mutually beneficial situation, an ecological niche was formed from which the protodog underwent novel morphological and genetic changes gradually leading to domestic dogs.

Close social contact of this kind requires that the animal in question possess a high fear threshold and a reduced tendency to flee, essential behavioral characteristics of domestication (Hediger, 1955/1968). Scientific evidence for a genetically divergent distribution of temperament traits based on relative tameness and confidence among canids has been demonstrated in the fox (Belyaev, 1979). Among farm-bred foxes, a small percentage exhibit a reduced tendency to act fearfully or aggressively in the presence of people. By breeding these less fearful individuals together over several generations, Belyaev has developed a strain of tame, human-friendly foxes (see below). Although a similar genetic basis for social tolerance has not been demonstrated in wolves, it is reasonable to assume that a certain percentage of the Pleis-

tocene wolf population was probably less fearful and aggressive toward humans than average wolves. The adaptive value of behavioral polymorphism in wolves and its relevance to domestication have been discussed in detail by Fox (1971) and by Scott, the latter writing,

> As a dominant predator the wolf is protected from certain kinds of selection pressure, thus permitting the survival of individuals with a considerable variation from the mean. As a highly social species, wolves should be subject to selection favoring variation useful in cooperative enterprises, as a greater degree of variation permits a greater degree of division of labor. For example, a wolf pack might benefit both by the presence of individuals that were highly timid and reacted to danger quickly and effectively, and also by the presence of other more stolid individuals who did not run away but stayed to investigate the perhaps nonexistent danger. (1967:257)

Similarly, Young and Goldman reported that "wolves held in captivity have shown that in each litter there are two or three whelps that show tameness early; the remainder are absolutely intractable and often die if one attempts to train them" (1944/1964:208–209). This prosocial population would have displayed a greater tolerance for human contact or may have even been "preadapted" for domestication—especially if they were not being actively hunted or persecuted.

Mutual tolerance offered many benefits for both species. Early people who tolerated scavenging and the proximate presence of dogs enjoyed a hygienic benefit (resulting in the control of garbage and pestilence) and a protected perimeter of barking dogs, providing valuable early warning of approaching enemies. After a propitious length of time, perhaps hundreds or thousands of years, such loose symbiotic contact may have resulted in the development of a specialized ecological niche in which the most tame individual wolves began to breed in close association with people. This transitional step would have taken place gradually, requiring little or no purposeful intervention on the part of early humans. Such a pattern of scavenging around human encampments by feral and semiferal dogs is evident in many parts of the world today (Fiennes and Fiennes, 1968). Even in large American cities, semiferal dogs satisfy the majority of their nutritional needs by scavenging (Fox, 1971; Beck, 1973). Alan Beck (1973) has observed that stray dogs satisfy most of their nutritional needs by raiding garbage cans and relying on handouts when garbage is not available. Handouts may have been an important source of food for early dogs as well. Domestic dogs exhibit a unique proclivity and skill for food begging—a behavioral attribute that would have been very useful for underfed primitive canines depending on human generosity for their survival. As the result of a growing familiarity between genetically "tame" scavengers and begging dogs, early people had many opportunities for close interaction, thereby making other social exchanges possible, including the adoption of pups.

John P. Scott (1968) has imagined that a primitive mother, having lost her own child and enduring the discomfort of lactation, may have saved a wolf puppy from the camp soup pot by adopting and nursing it as her own. If, in addition, the wolf happened to be a female, it might have chosen the camp as a suitable place to give birth, resulting in a new generation of even closer interaction and social affiliation. Although such a scenario cannot be proven, it is statistically possible, even plausible. Many examples of the suckling of domestic animals by women have been found among existing tribal cultures (e.g., the Papuan of New Guinea).

Although primitive humans' intentions and purposes for keeping dogs in close proximity are not known, a certain degree of social tolerance and mutual acceptance was clearly present in both species. In addition to various utilitarian or symbiotic benefits, early interaction between humans and dogs surely depended on a high degree of respectful deference shown by early canids toward humans. Dogs exhibiting threatening tendencies would have been quickly expelled or killed, and eliminated from the gene pool early in the domestication process. Those animals exhibiting submission behaviors and social subordination—that is, a readiness to respond to human directives—would have been more

likely to survive and to reproduce under the protection of domestic conditions. Early domestic dogs that also exhibited a high degree of affection toward their captors would have been brought into even closer intimacy, enjoying added protection, better food, and other survival advantages not extended to less affectionate counterparts. As time went on, various specialized functions could have been elaborated out of this basic foundation, including all the familiar roles served by the dog today—for example, alarm barking and protection, hunting activities, herding, draft work, and companionship. Undoubtedly, at some point in the natural history of humans and dogs, interspecies tolerance and cooperative interaction became mutually advantageous, thus forging the foundation for a lasting relationship.

Terms and Definitions: Wild, Domestic, and Feral

Reports following a recent fatal wolf-dog attack exemplify some of the confused ways in which terms like domestic, wild, and tame are used. The victim, a 39-year-old mother of two, was mauled and killed as her children looked on near their Colorado home. Several authorities were asked to comment on the unusual attack. It was the first documented case in which a wolf hybrid had killed an adult person. A police detective investigating the incident said, "They [wolf hybrids] may be domesticated, but they're still wild animals subject to unpredictable behavior." Another authority, speaking for a local Humane Society, commented, "Animals like that are not tame. You can pet them but they are wild." The words *tamed* and *domesticated* are used here interchangeably, as though they mean about the same thing, roughly synonyms for *pet*. But this habit of usage is misleading. Taming is a necessary prerequisite for domestication, but taming alone is not sufficient. Many wild animals can be readily "tamed" by patient handling and socialization, but they cannot be classified as domestic animals until they have also undergone extensive behavioral and biological change resulting from selective breeding over the course of many generations. Such breeding is designed (consciously or unconsciously) to enhance various behavioral and physical characteristics conducive to domestic harmony and utility.

The words *wild* and *feral* are also frequently used interchangeably in popular discussions. The feral dog is not simply wild, but is a previously domesticated animal that has been released or has escaped back into nature to reproduce and fend for itself. As is discussed below, dingoes exemplify many characteristic features of feral dogs, having evolved from early Asiatic dogs that escaped domestic captivity on reaching Australia several millennia ago. Since that time, dingoes have reverted to a feral existence with only temporary symbiotic affiliations with humans. Dingoes have existed under such conditions of quasi domestication for many generations without actually returning to a true domestic state.

The Dingo: A Prototypical Dog

An excellent source of ethnographic evidence outlining the general course of early domestication can be found in the enduring relationship between the Aborigines of Australia and dingoes. This symbiotic dyad provides a valuable anthropological picture of what life between primitive humans and early canids may have been like during the earliest incipient stages of domestication. In most details, dingoes differ only slightly from Asian wolves (*Canis lupus pallipes*), except for modest behavioral and morphological changes associated with quasi domestication—for example, variable tail carriage (sometimes carried in the sickle-like form of dogs), some evidence of piebald marking (especially on the feet and chest), and occasionally lop-eared examples are observed but are probably the result of European hybridization. Like wolves, dingoes do very poorly as domestic animals—even after they have been crossed with domestic dogs (Trumler, 1973). The pelage of dingoes comes in a wide variety of colors, including black, white, black and tan, brindle, and ginger tan—the most common color observed (Corbett, 1995).

Meggitt (1965) has reviewed the relevant recorded literature regarding dingoes and their varied role in aboriginal culture. He has

expressed skepticism regarding the usefulness of dingoes in hunting. Some evidence suggests, however, that a cooperative hunting relationship may have existed at various times and in ecologically specialized niches like tropical rain forests. Aboriginal hunters have been known to track free-ranging dingoes on the trail of prey and taking it as their own once the quarry was caught, leaving the dingoes with scraps and offal for their efforts. Corbett (1995) reports that the Garawa tribe of northern Australia uses dingoes to track and worry wounded prey, allowing the hunters to catch up and dispatch the weakened and distracted animal. However, in other localities like the desert, camp dingoes are driven back at the outset of a hunting expedition because they are considered a hindrance rather than an aid to a hunter's prospects of finding game (Gould, 1970). Nomadic Aborigines hunt by concealment and stealth, making dingoes of limited value to such efforts. As an independent predator, dingoes sometimes hunt cooperatively in small pack units, especially when hunting large prey (e.g., kangaroos). However, they are seldom observed to congregate in such packing groups. Of 1000 dingoes sighted by Corbett and Newsome (1975), 73% were solitary hunters, 16.2% were in pairs, and only 5.1% were observed in trios.

Aborigines routinely collect puppies during the winter months from remote denning sites and rear the captured progeny to puberty. Upon reaching sexual maturity, the captive dingoes usually escape into the bush to reproduce and never return. This pattern of adoption and escape prevents the development of a true domesticated dingo, since its breeding is not actively controlled and directed by human design. It should be noted, however, that deformed or otherwise unsuitable puppies are culled and eaten, thus providing some degree of active selection. Further, it is likely that those dingoes not performing well under domestic conditions are either expelled or killed. Although Aborigines find dingo meat somewhat unpalatable, they will eat it if hungry enough. In various parts of Southeast Asia and the Pacific Islands, dogs are preferred over pigs and fowl as meat. Corbett (1995) speculates that the first dingoes reached Australia as cargo—a source of fresh food—but, once having reached shore, some may have fled into the bush to give birth and to fend for themselves.

Apparently, some puppies belonging to Aboriginal women are purposely crippled by breaking their front legs to prevent them from wandering off. A similarly pragmatic rationale may inform the constant pampering (sometimes involving suckling) and attention that dingoes are given by their Aboriginal captors. Such caregiving interaction may establish a strong psychological "leash" of augmented affectional bonding and heightened dependency. In 1828, the explorer Major Lockyer noted the strong emotional attachment between the Aborigines and their dingo puppies. He had taken a liking for a black puppy in the possession of a native, offering him an ax in exchange for the dingo. Urged by his companions to accept the offer, the Aborigine nearly conceded to the trade "when he looked down at the dog and the animal licked his face, which settled the business. He shook his head and determined to keep him" (in Bueler, 1973:102). These sentiments were later echoed by Lumholtz (1884, in Corbett, 1995), reporting that the Aborigines treated their dingo puppies with greater attention and care than given to their children. He describes the character of this relationship and interaction in highly affectionate terms: "The dingo is an important member of the family; it sleeps in the huts and gets plenty to eat, not only of meat but also of fruit. Its master never strikes, but merely threatens it. He caresses it like a child, eats the fleas off it, and then kisses it on the snout" (1995:16). The treatment observed by Lumholtz appears to represent an exception rather than a general rule. While treated with great fondness, the camp dingoes are often maintained in poor health and fed the poorest scraps or nothing at all—forced to fend for themselves on what they can find. Meggitt (1965) points out that domestic dingoes can be distinguished from free-ranging counterparts by their starved appearance. Among Aborigines, dingoes are kept mainly as pets, as warm sleeping companions, as scavengers of garbage and excrement, and as watchdogs.

Richard Gould (1970), an anthropologist, made several interesting observations of the interaction and bonding between Aborigines and dingoes during a brief study involving a remote group who had limited or no previous contact with Europeans. The group of Aborigines in question lived in a remote and barren area of the Gibson Desert called Pulykara located in Western Australia. They existed on the meager bounty of desert fauna and flora, mainly consisting of vegetable food, although meat was preferred whenever available. Among the 10 Aborigines forming the group were 19 dingoes, 12 of which belonged to a single woman, whom Gould christened the "Dog Lady." Although the dingoes were frequently petted and fussed over, the people rarely fed them. He noted that the dingoes were not only "the skinniest dogs I have ever seen, but they were also compulsive cringers and skulkers" (1970:65), surviving on what they could find around the camp or by stealing. Paradoxically, the people expressed great sensitivity for their dingoes' plight. One woman, upon receiving a piece of candy from the researcher, covered her dingo's eyes so that the dingo could not watch her eating it.

The Dog Lady is particularly interesting because of the manner in which she pampered and cared for her dingo companions. While she rarely fed the animals, she took great pains to make them comfortable. During the day, they slept under "shade shelters" constructed out of branches and twigs that she would periodically adjust in order to keep them maximally protected from the sun. While the desert days are hot, the nights are freezing cold. The custom of the Aborigines is to sleep around a small campfire, huddled among dogs. The Dog Lady, as one might guess, had most of the pack wrapped around her, suggesting that a large motivation for keeping so many dogs was comfort against the cold desert nights. One night Gould attempted to take a photograph of the group while they slept with their dogs. The flash of the camera startled the dingoes, causing them to run away into the night. The people were left shivering without their "doggy blankets." It appears from Gould's observations that the most important utilitarian function of the camp dingoes for this particular group was that of a living blanket.

The Carolina Dog: An Indigenous Dog?

Research led by I. L. Brisbin at the Savannah River Ecology Laboratory is under way to determine whether a dingolike dog that has been discovered living in the Savannah River Reserve and other remote areas of South Carolina is an indigenous dog with an ancient lineage or a more modern counterpart that has become feral (Brisbin and Risch, 1997; Weidensaul, 1999). In either case, the Carolina dog portends to reveal important information about the nature of domestication and its reversal. Carolina dogs present a number of behavioral and ecological adaptations that are not observed in other domestic dogs, suggesting a unique evolutionary course of development. For example, females exhibit an unusual pattern of multiple estrous cycles (3/year) as young dogs, with longer periods between estrous cycles occurring as they grow older. Brisbin and Risch speculate that this pattern of reproduction is particularly adaptive under conditions where a high risk of early death exists. A young Carolina dog quickly produces one or more litters as soon as possible after reaching sexual maturity. The threat of diseases such as heart worm—a mosquito-born condition that is rampant in the South—may exert selection pressures that favor dogs who exhibit a more frequent pattern of estrous cycles. Another unusual feature exhibited by female Carolina dogs is their tendency to dig dens in which to whelp their young. Domestic dogs typically do not dig dens before whelping their young. When in estrus or after giving birth, females also exhibit the rather unusual habit of burying their feces by covering it with sand that is pushed about by their nose. Another unusual behavioral oddity found in these dogs is their avidity for digging "snout pits"—small holes dug in the shape of their muzzle. The function of such behavior has not been determined, but Brisbin speculates that the dogs may be deriving some nutritional value from eating the soil (geophagia). In addition, unlike most domestic dogs, Carolina dogs exhibit effective predatory behavior that enables

them to survive independently of human protection and care. A central hypothesis that Brisbin is testing concerns the possibility that the Carolina dogs may be a vestige of primitive dogs that accompanied human migrations across the Bering land bridge. Whether the Carolina dogs possess a true dingolike genetic ancestry is a question that is being currently evaluated through behavioral and mitochondrial DNA studies.

Biological and Behavioral Evidence

Biological Evidence

Domestic dogs interbreed with three wild canid species: coyotes, jackals, and wolves. Charles Darwin (1875/1988) discusses at length in *The Variation of Animals and Plants Under Domestication* that the variability and diversity of the dog could only be adequately explained by postulating an admixture of several wild species represented in the canine genome. Following in the tradition of Darwin, Konrad Lorenz (1954) also argued that domestic dogs owe their genetic endowment to a combination of canid bloodlines. He believed that the dog was first domesticated from the jackal (*Canis aureus*) and only later crossed with the wolf. However, upon subsequent reexamination of the behavioral evidence, Lorenz (1975) reassessed and reformed his theory by substituting *Canis lupus pallipes* in place of the jackal. An important factor affecting his change of opinion was the finding that jackals are much less sociable and exhibit a distinctive howling pattern not shared by dogs.

"The wolf, disarmed of ferocity, is now pillowed in the lady's lap." This speculation written by Edward Jenner in 1798 has turned out to be true. The genetic and behavioral evidence to date points uniformly to the wolf as the exclusive wild progenitor of the dog. Supporting this view is the fact that both dogs and wolves share a very similar genotype and readily interbreed. Testifying to the ease with which wolves and dogs interbreed is the growing population of wolf-dog hybrids. It has been roughly estimated that approximately 300,000 wolf-dog hybrids are currently kept as companion animals in the United States (Clifford and Green, 1991), although these numbers have been disputed and remain controversial.

Robert Wayne (1993) has confirmed the close genetic relationship between dogs and wolves by comparing the mitochondrial DNA sequences of wild canids and dogs. According to this line of research, dogs are domesticated wolves with only slight genetic alterations affecting developmental timing and growth rates: "Dogs are gray wolves, despite their diversity in size and proportion; the wide variation in their adult morphology probably results from simple changes in developmental rate and timing" (1993:220). Both wolves and dogs possess 78 chromosomes (Table 1.1). Comparisons of canid DNA sequences reveal that dogs are more closely related to wolves than to coyotes. Al-

Table 1.1. The diploid chromosome numbers for canids showing a close relationship between the dog, wolf, coyote, jackal, and other canids

Species	Common name	Range	Chromosomes
Canis aureus	Golden jackal	Old World	78
Canis lupus	Gray wolf	Holarctic	78
Canis iatrans	Coyote	North America	78
Cuon alpinus	Dhole	Asia	78
Lycaon pictus	African wild dog	Sub-Sahara Africa	78
Speothos venaticus	Bush dog	South America	74
Chrysocyon brachyurus	Maned wolf	South America	76
Vulpes vulpes	Red fox	Old and New World	36
Alopex lagopus	Arctic fox	Holarctic	50

Source: After Wayne (1993:219).

though coyotes can interbreed successfully with dogs and produce fertile offspring, the coyote is eliminated as a significant contributor to the dog's evolution by virtue of geographical considerations. Any possible role the coyote may have played in the origin of the dog is negated by the fact that its range is limited to North America and it is not found in any of those areas associated with the dog's earliest appearance. The DNA sequencing of the dog's genotype differs from the wolf's by only 0.2%, whereas the coyote's genotype differs by about 4%. Although the jackal may be represented to some extent in the dog's genotype, the jackal does not appear to be an important genetic contributor to the dog's evolution.

Behavioral Evidence

Another important source of evidence in favor of the primogenitor status of the wolf is the behavioral similarity between the two canids. Scott (1950) has compiled an ethogram of dog behavior derived from observations of semiferal dogs maintained in open-field enclosures and well-socialized counterparts maintained under laboratory conditions. He then compared these observations with field reports of wolf behavior. Of the 90 behavior patterns exhibited by dogs, all but 19 are also exhibited by wolves. Most of the behaviors not described at the time of Scott's ethogram have been subsequently reported by other observers (Mech, 1970; Fox, 1971). Scott's study demonstrates that the behavior patterns of dogs are very similar to those of wolves.

An interesting example of behavioral parallelism between wild canids and dogs is the *play bow*—an apparent invitation to play. Bekoff (1977) has observed that the form and function of the play bow is similar among young dogs, coyotes, and wolves. Among canids, the play bow is a stereotypic, "relatively" fixed action pattern signaling playful intentions. Another highly social and affiliative display shared by dogs and wolves is an enthusiastic greeting ceremony in which reciprocal affectionate and solicitous behavior is exchanged between pack members on return from excursions or upon waking from sleep. The behavioral components expressed during these animated displays include facial gestures indicating pleasurable excitement and vigorous tail wagging—the canid equivalent of the human smile.

Besides the ubiquitous play bow and greeting ritual, dogs and wolves share many expressive facial and bodily movements employed to communicate threat and appeasement intentions. These behaviors occur under various social circumstances, but especially during ritualized dominance challenges and squabbles. Rudolph Schenkel (1967) has analyzed in detail the submissive behavior of wolves and dogs. His work is of considerable historical and theoretical importance in the clarification of canid appeasement displays, particularly with regard to the differentiation of active and passive submission behaviors (Fig. 1.4).

Understanding dog behavior rightly begins with a study of wolf behavior. However, a long history of domestication behaviorally segregates dogs from wolves, and one must take care not to overly generalize between the two canids in terms of their respective motivations and behavior patterns.

EFFECTS OF DOMESTICATION

Although it is doubtful that early humans consciously deliberated upon the reproductive activities of their captive dogs, there certainly existed many unconscious selection pressures. Dogs of special interest or usefulness were probably more carefully managed, fed, and protected than others, thereby enhancing their chances of survival and reproduction. Darwin (1859/1962) reported striking evidence revealing the high regard and protection that dogs enjoyed in some tribal cultures. In support of the existence of such unconscious selection pressures, he reports that the tribal people of Tierra del Fuego would sooner eat one of their old women in times of famine than one of their favorite dogs:

> If there exist savages so barbarous as never to think of the inherited character of the offspring of their domestic animals, yet any one animal particularly useful to them, for any special

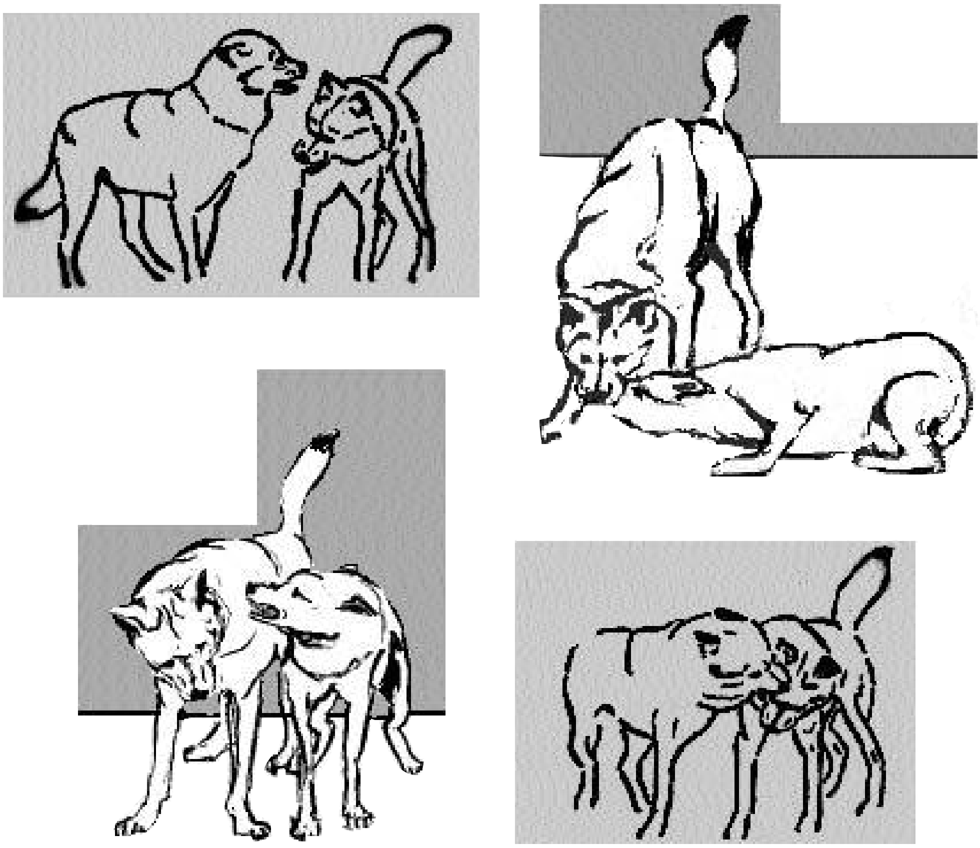

FIG. 1.4. Changes in bodily posture express relative dominance and submission. The dominant wolf can be identified by his upright tail carriage. After Schenkel (1967).

> purpose, would be carefully preserved during famines; other accidents, to which savages are so liable, and such choice animals would thus generally leave more offspring than the inferior ones; so that in this case there would be a kind of unconscious selection going on. We see the value set on animals even by the barbarians of Tierra del Fuego, by their killing and devouring their old women, in times of dearth, as of less value than their dogs. (1859/1962:51–52)

Morphological Effects of Domestication

The effects of domestication have resulted in dramatic and extensive alterations of the wolf's morphology. The archeological remains of the dog show a number of structural changes associated with domestication, including smaller skeletal size, a short compact muzzle, crowded dentition and proportionately smaller teeth, ocular orbits set more toward the front, the cranial capacity of the skull is reduced, and, finally, the domestic dog's cranium is proportionately wider and possesses a more sharply rising stop (Morey, 1992). Over the course of the dog's domestication, the shape of its skull has been modified in two opposing directions (Fig. 1.5). In the case of bulldogs, for example, the skull has been simultaneously shortened and widened, whereas in greyhounds it has been lengthened and narrowed. Another important morphological feature differentiating dogs from wolves is the carriage of the canine tail.

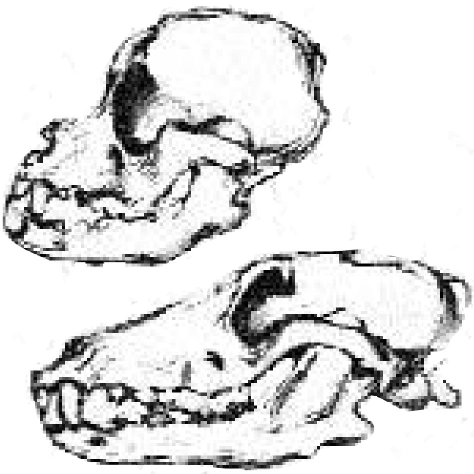

FIG. 1.5. These skulls show the opposing tendencies of shortening/widening (brachycephalic) and lengthening/narrowing (dolichocephalic) of the cranium.

Most dogs carry their tails in either a tightly curled or sickle-like shape—a tail shape that wolves never (or rarely) exhibit. The general conformation of the average dog differs considerably from that of the wolf. The wolf's general physical structure is one of harmonic cooperation between form and function. A wolf's shoulders are narrow with elbows turned inward causing the front legs to move along in a single line with the rear ones. The coordination is so accurate and refined that the hind feet follow in the tracks of the front ones. The consequence is efficient locomotion involving graceful trotting and loping movements that are not commonly observed in dogs.

An interesting physical oddity that can be found on the feet of domestic dogs but not normally exhibited by wolves is metatarsal dewclaws. Many large breeds (Great Pyrenees, St. Bernards, Newfoundlands) exhibit dewclaws on their hind feet. Some dogs even exhibit a pair of vestigial dewclaws on their hind feet; these vestigial dewclaws are attached to the feet with little more than skin. The absence of paired dewclaws in the briard is a disqualifying fault. Alberch (1986) has pointed out that dewclaws on the hind feet are observed only among large dogs and are rarely seen in smaller breeds like the Chihauhau or Pekingese. He has proposed that large dogs may exhibit such dewclaws as the result of embryological differences occurring early in development—that is, the embryos of larger breeds have larger limb buds containing more cells than smaller breeds. This hypothesis, however, does not explain why many large breeds do not exhibit metatarsal dewclaws. Another possible explanation for extra digitation is genetic drift or founders effect stemming from the early population of dogs common to those animals exhibiting the trait.

A great deal of attention has been focused on anatomical differences between the dog's cranium and dentition and those of wild canids. This reliance is partly due to the paucity of complete dog skeletons in the archeological record. Most existent remains of the early dog are limited to the jaws and teeth. An important morphological difference between the wolf and the dog is that the latter's canine teeth appear to be proportionately smaller (Olsen and Olsen, 1977). Morey (1992) has questioned the validity of this widely held view and has proposed an alternative explanation for the observed differences. He has argued that the body size of some large breeds may have increased faster than corresponding dentition size—that is, the teeth have not become proportionately smaller, but the body has become larger. He points out that smaller dogs often have proportionately larger teeth than wolves, suggesting a similar alteration but in an opposite direction—that is, the body has become smaller at a rate faster than a proportionate decrease in the size of the teeth. It should be noted, however, that even for the untrained eye, the canine teeth of wolves are impressively large when compared with the canine teeth of average dogs. Although the dog and the wolf share the same number of teeth (20 upper teeth and 22 lower for a total of 42 permanent teeth), the dog's teeth are often crowded together in a proportionately shorter and wider jaw.

TABLE 1.2. Some behavioral differences between the wolf and dog brought about through domestication

Behavioral tendency	Wolf	Dog
General activity level	High, varies with rank	Varies with breed—hypo- or hyperactive
Exploratory behavior	High, varies with rank	Significant sensory specialization
Neophobia	Low threshold/slow habituation	High threshold/rapid habituation
Vocalization	Very common	Less common, includes barking
Group howling	Rare—threat only	Common in many situations
Barking	Absent	Common
Yelping		
Agonistic displays		
Hip slams	Common	Rare—wolflike breeds
Muzzle biting and pinning	Dominant display	Rare—wolflike breeds
Vertical tail threat display	Dominant display	Threat—tail arched
Face licking (greeting)	Common—low frequency	Common—high frequency
Secondary social bonding	Weak	Strong, except guard dogs
Trainability	Weak	Strong
Allelomimetic behavior	Strong	Strong in some breeds (hounds)
Dominance	Complex, basically linear	Common but highly variable
Fighting	Varies with rank	Varies according to breed
Sexual behavior		
Maturation	2 Years	6–9 Months
Female season	Annual estrus	Biannual estrus
Male season	Seasonal spermatogenesis	Constant spermatogenesis

Source: After Fox (1978:253–256). See references following Chapter 1.

Behavioral Effects of Domestication

Although dogs share a great many behavioral characteristics with wolves, the former have undergone a tremendous transformation in the direction of enhanced docility and affectionate dependency as well as many other behavioral changes (Table 1.2). Price has argued that these changes are probably not due to a permanent loss of behavior, but rather reflect quantitative alterations (lowering or raising) of response thresholds mediating the expression of species-typical behavior:

> With respect to behavior, it appears that domestication has influenced the quantitative nature of responses. The hypothesized loss of certain behavior patterns under domestication can usually be explained by the heightening of response thresholds above normal levels of stimulation. Conversely, lowered thresholds of response often can be accounted for by excessive exposure to certain forms of stimulation. (1998:55–56)

Whether as the result of quantitative or qualitative evolutionary changes, and despite occasional atavistic examples to the contrary, most dogs have lost the lupine carnivorous drive and predatory behavior exhibited by wild canids. Dogs appear content to eat practically whatever food they are given, even though it is often far removed from the diet which their ancestral progenitors enjoyed. Most dogs, however, still exhibit a definite preference for meat whenever it is available. Dogs tend to mature physically and sexually much more rapidly than wolves: the former become sexually active (on average) between

7 and 10 months, whereas the latter reach sexual maturity at approximately 22 months of age (Mech, 1970). There exists a great deal of variation with regard to the onset of puberty in dogs. Smaller dogs tend to reach puberty earlier than larger ones. Dogs have become polygamous and readily accept multiple sexual partners, whereas wolves tend to be more selective and monogamous. This change in sexual preference away from a single mate enables dogs to breed more freely with partners defined by *breeders*—an essential facet of domestication. Another aspect enhancing canine reproduction is the dog's biannual breeding cycle in contrast to the wolf's annual breeding cycle. Whereas male wolves are able to breed only during a short period once a year, male dogs can breed any time a female is receptive. An interesting aspect of wolf sexual behavior involves the seasonal control of spermatogenesis. At times other than the breeding season, the male wolf's testes atrophy, rendering the wolf infertile. Male dogs are not subject to such variations of testes size or fertility. Dogs are fertile all year round.

Two behavioral patterns exhibited by wolves that have become strongly exaggerated in domestic dogs are alarm barking and urinary scent marking. Although wolves exhibit both forms of behavior, they perform them far less frequently than dogs. When alarm barking does occur among wolves, it is a subdued or whispered "wuff, wuff" sound. Zeuner (1963), however, has noted that the southern Asian wolf (*Canis lupus pallipes*) has been reported to bark in a manner resembling that of the dog.

It should be noted that not all domestic dogs are equally inclined to bark. The absence of barking in dogs belonging to native American Indians was frequently noted in the journals of early observers (Young and Goldman, 1944/1964). In fact, Spanish explorers of the New World referred to native dogs as *perros mudos* (mute dogs). These native dogs, however, gradually acquired the habit of barking, presumably as the result of close daily contact with their more vocal European-bred counterparts. This observation suggests that the tendency to bark may be socially facilitated or learned. Barking definitely has a contagious quality, as anyone who has lingered about the outside of a kennel can verify. Interestingly, European-bred dogs appear to have been affected by this "canine cultural exchange" but in a reverse way. Columbus is reported to have complained that his European-bred dogs had lost some of their valuable inclination to bark as the result of contact with the "mute" native dogs (Varner and Varner, 1983).

Even among modern breeds, the tendency to bark is marked by wide variability. Although many dogs bark a great deal (e.g., Shetland sheepdogs), others do so only infrequently (e.g., Akitas), and some nearly not at all (e.g., basenjis). The advantage of a lower response threshold for barking may seem obvious to the average homeowner, but Coppinger and Feinstein (1991) have disputed the functional and communicative value of the dog's barking behavior. They have argued that barking behavior is poorly directed, excessively ambiguous, "indecisive"—even "meaningless." They conclude that the dog's increased tendency to bark is an inadvertent symptom of domestication, that is, a paedomorphic elaboration and by-product, rather than a genetically selected tendency. Clutton-Brock (1984) has argued the opposing point of view, stating that it is likely that the dog's barking behavior has undergone "intensive selection" because of its value as an early warning that signaled the approach of intruders. Undoubtedly, considerable attention has been focused on the selection of alarm barking by dogs. A dog exhibiting such barking would naturally have been more valued as a protector than a dog not moved to bark at strange or suspicious sounds. Among trailing hounds, the melodious baying or "voice" is a highly valued breed feature that has been carefully selected for in the breeding of such dogs.

Spectrographic analysis of the dog's bark reveals that it is a composite of growling (threatening) tones and whining/yelping (distress or appeasement) tones, making the bark itself appear ambivalent or flexible with regard to intention and meaning. Coppinger and Feinstein (1991) contend that such ambivalence of meaning reduces the value of the bark as communicative signal. It may be pre-

cisely the bark's flexible ambivalence, though, that makes it so communicative and meaningful. The bark as a signal is composed of the two extremes of threat and distress on a continuum admixing these two opposing intentions and sources of meaning. To define precisely a dog's current intentions, which may, in fact, be ambivalent or expressive of any number of other graduated shades of intention, the bark leans intentionally in the direction of increasing threat or distress as required by the situation. A growling, deep-throated bark thrust forward with forceful bodily movement is clear to any intruder approaching a guard dog, just as the insecure yapping of a separation-anxious dog is clearly understood as a distress call for social contact.

Often the precise meaning of any particular segment of barking depends on the presence of additional context-related information specifying a more exact delineation of the intent motivating the barking behavior—for example, the dog barking to be let outdoors may also scratch at the door. Fox (1978) has interpreted the hypertrophy of canine barking behavior in terms of an expanding set of situations in which the bark is used as a signal. As a result, the meaning of the dog's bark has suffered in terms of specificity, making it necessary to incorporate other supplemental signals to help specify a more exact intention and meaning. These supplemental signals belong to other sensory modalities (e.g., sight, smell, and touch). Barking, from this perspective, is a general means of attracting attention to more specific communicative signals. However, this altered function of barking is far from meaningless, but significantly extends—rather than limits—the dog's ability to communicate. Barking is not an arbitrary activity, but a highly adapted communicative system used to express various intentions or states of alarm, conflict, and need.

Many dogs exhibit an almost compulsive urge to investigate and scent mark the environment with urine. Such excessive urinary scent marking is not observed among wolves. Although an urge to communicate appears to motivate the habit, the precise meaning and purpose of scent marking by dogs is not known. Scott (1967) has argued that canine scent marking does not serve a territorial function, but rather functions more or less to communicate that the dog has been recently in the area. Overmarking may be used by a dog to personalize its surroundings, thereby making them more familiar and secure. If there is an anxiety-reducing aspect associated with scent marking, it may help to explain the often excessive character of such behavior and some common behavior problems associated with it. Recent studies involving stray and feral dogs indicate that, under "natural" conditions, scent marking and territorial defense may assume a more wolflike character among such dogs (Font, 1987; Boitani et al., 1996). Among wolves, scent marking is associated with the declaration of territorial rights or rank (Peters and Mech, 1975). Their urinary scent marking occurs most frequently during the breeding season and is the prerogative of the alpha male and female. Subordinates usually urinate by squatting.

Besides the aforementioned social and territorial functions of lupine scent marking, Harrington (1981) has found that urine marking is also employed by wolves to identify emptied caches of food. He observed wolf urine marking activity around caches that he had prepared by digging large holes and placing several chicks into them. He observed that wolves rarely (and then, perhaps, by mistake) urinated on caches containing food, whereas they consistently urinated on caches emptied of their content. The empty cache often was marked rapidly (within a minute or so) after it was emptied, usually by another wolf. Harrington speculates that such urine marking is employed to render exploitation of caches more efficient. The smell of urine signals to foraging wolves that no more food is available in the cache despite the presence of lingering food odors.

Another behavioral area where dogs significantly differ from wolves involves the display of aggressive behavior patterns. An average dog is much more docile, submissive, and trainable than a wolf. These qualities make dogs more responsive and adjustable to life in close association with humans. Although domestic dogs are not entirely free of troublesome dominance testing and even aggression, wolves, on reaching sexual and social maturity, tend to compete much more aggressively

and earnestly for social status. The fighting styles of dogs and wolves differ significantly. Dogs, for instance, tend to limit their attacks to the head, neck, and shoulder. Wolves, on the other hand, make greater use of body blocks and, during damaging fights, may attack extremities—injuries to which render an opponent very vulnerable. Another important difference between wolves and dogs is the latter's social openness and tolerance toward strangers. Dogs are typically much more friendly toward strangers than are wolves, and appear to treat outsiders as members of an extended pack-family, whereas wolves become progressively xenophobic and intolerant of strangers not belonging to their immediate pack.

An important influence of domestication on the behavior of dogs is the attenuation of predatory instincts. Wolves possess a set of innate predatory behavior patterns that are readily evoked by an adequate stimulus. When presented with a prey animal, wolves respond in a species-typical manner by emitting an appropriate series of behavioral sequences, ranging from crouching, stalking, worrying, charging, pouncing, biting, and shaking. Faced with the same prey stimulus, dogs may do little more than play or tease the target animal. The *predatory response* of the wolf is so constant and uniform that the relative amount of lupine heredity expressed in a wolf-dog can be roughly estimated by comparing its behavior with a wolf serving as a control (E. Klinghammer, personal communication). The display of predatory behavior by wolf-dog hybrids is of considerable concern, especially with regard to young children who, in their awkward movements and screaming, may appear as distressed prey to a poorly socialized hybrid.

Many authorities have speculated that wolves are more intelligent than dogs, sometimes attributing this alleged difference to the fact that wolves must "work" for their living. Another line of reasoning correlates variations in proportional brain sizes with relative intelligence. Hemmer (1983/1990) has estimated that the domestic dog's brain is 25% to 45% smaller than the brain of the northern wolf (*Canis lupus lupus*), depending on several genetic and habitat (geographic and climatic) variables. The majority of European breeds are ranked at an intermediate level, ranging between 25% and 35% smaller than the wolf. A great deal of variation exists among the various breeds, but none of the modern breeds exhibit a brain size (relative to bodily proportions) comparable to the northern wolf varieties. Although these measurements are very suggestive and statistically significant, differences in intelligence can not be directly extrapolated on the basis of brain size alone.

Although such speculation is fascinating, it may be more productive to study relative intelligence among canids by comparing their performance under controlled conditions and to discuss intelligence in terms of quantifiable learning skills and problem-solving abilities. Further, there may not exist a general intelligence factor per se, but rather a set of various talents or individual "intelligent" abilities. Frank and Frank (1983) have found that wolves perform problem solving and other insight-driven learning activities better than dogs, whereas dogs perform tasks involving rote learning and inhibition better than wolves. However, it should be noted that wolves are much more reactive to forceful handling than are dogs, the former being quick to deliver warning bites or to retreat whenever they are exposed to such treatment. Consequently, it is hard to judge from their experiment whether intelligence or reactive emotionality is being measured. Another possible factor confounding their results is the effect of competing species-typical avoidance reactions (Bolles, 1970), which are adjusted through domestication to a higher threshold in dogs than in wolves.

Other researchers have found a similar differentiation of learning abilities in wolves and dogs as that reported by the Franks above. For example, Hemmer (1983/1990) found clear differences between dogs and wolves in problem-solving abilities. In his simple test, animals were tethered in front of a short length of cord that was attached to a piece of food placed just out of their reach. By manipulating the cord, the subjects could pull the food toward themselves and eat it. Most of the dogs tested eventually solved the problem, given enough time. The wolves solved

the problem rapidly, with some of them solving the problem without hesitation on their first attempt—an apparent display of insight that was not exhibited by any of the dogs. Mech reports an anecdote involving a high degree of insight learning in a wolf who had learned how to escape from his pen:

> Once a wolf has learned how to escape from a pen, for example, it is almost impossible to keep the animal in. One such escape artist I knew learned to raise a drop door in its pen by jumping to the top of the eight-foot-high pen, and grabbing with its teeth the door cable on the outside of the pen, which was exposed to the inside through a three-inch gap. By jumping up and grabbing the cable, the wolf could lift the door at the bottom of the cage. After the wolf raised the door many times, it stuck in the "up" position, and the wolf ran out! (1991:26)

Humphrey and Warner (1934) reported early efforts to train wolf-dog hybrids for police and military work. They found that the hybrids did well on leash, but became uncontrollable when they were worked off-leash. Macintosh (1975) found that dingoes are virtually untrainable in obedience. Even the intensive efforts of well-experienced police dog trainers were unable to obtain "anything resembling obedience" in dingoes.

Paedomorphosis

Many of the changes occurring as a result of domestication appear to involve the prolongation of puppylike or juvenile characteristics into adulthood. The overall outcome is a neotenization of the wild prototype—a process in which maturity is developmentally delayed and growth rates altered (Fox, 1967). In many ways, an adult dog behaves and looks like a juvenile wolf. All of these characteristics (soft coat, curled tail, skinfolds, floppy ears, and short legs) give the domestic dog a puppylike appearance when compared with the wild visage of the wolf. Among the most neotenous of the modern breeds are various Eastern "toys" like the Pekingese, shih-tzu, and Japanese spaniel. These breeds are not only socially dependent and diminutive, they are soft and cuddly to touch and can be easily held on the lap or embraced like a baby. Behaviorally, they are very receptive to the admiring attention of their human keepers and happily entertain hours of affectionate handling and petting. In addition, such toy breeds exhibit other notable infantile characteristics that invite parental care, including protuberant and tearing eyes, brachycephalism (extreme shortening of the muzzle), short legs, a "cute" curly tail, and floppy ears.

Along with the aforementioned structural changes, several behavioral changes can be detected in the direction of youthfulness. These behaviors are usually exaggerated forms of neonatal behavior topographies normally perpetuated into adult behavior and integrated into the animal's social signaling system. Zimen (reported by Fox, 1971) has compared the emergence of social behavior in the wolf and the domestic dog (standard poodle). He found that dogs exhibit a pronounced delay of social spacing, as defined by social distance and the number of direct contacts between conspecifics, in comparison to the time table followed by wolves. By 6 months of age, wolves begin to distance themselves from other conspecifics, whereas a corresponding behavior does not appear in dogs until 12 months of age. By the time wolves are 18 months old, they exhibit adult-like independence under open-field conditions, ranging far and wide from companions. Poodles, on the other hand, were never observed to split off from group members for any length of time.

On the whole, domestic dogs appear in many respects to act like 4- to 6-month-old wolf puppies. This tendency is also reflected in patterns of daily activity. Adult wolves tend to follow a crepuscular pattern of activity, being most active in the early morning and evening, whereas the young wolves exhibit a more erratic activity pattern, moving more rapidly from periods of rest to activity than the adults. Adult poodles are much more like immature wolves in this regard, being more easily aroused into spontaneous activity than adult wolves. Zimen interprets these developmental differences as a paedomorphic phenomenon resulting from the dog's domestication.

Zimen (1987) has also noted that dogs are distinguished from wolves by the ease with which dogs form social affiliations with humans. Wolves only form social bonds with humans in the absence of adult conspecifics and fear. Dogs, on the other hand, readily form such attachments, often preferring human contact over contact with conspecifics when given the choice. Zimen concludes that besides "reducing flight tendencies, domestication has thus strongly increased the motivation to seek social contact with man" (1987:290). Although wolves can be tamed and socialized to a great extent, they never attain the full range of social responsiveness that is exhibited by most domestic dogs. When the two species are compared as adults, dogs appear to be much more playful and socially flexible than wolves. Social "promiscuity" is an innate temperament feature of dogs that has resulted from many generations of unconscious selection for reduced agonistic behavior and playfulness:

> Unlike the wolf, many dogs show not the least wariness towards strange people, and immediately accept them, showing passive and active submission behaviour. This type of dog—its temperament and general demeanor—certainly resembles that of a five-week-old puppy or wolf cub trustingly accepting all comers. It is not inconceivable that this behavioural paedomorphosis, or perpetuation of infantile behaviour patterns into adulthood, and the absence of fear of strangers are the result of generations of domestication, facilitated by early socialization to a wide variety of people in different social situations. ... This "wariness", which is so characteristic of the wild temperament of the wolf, appears to have been selectively eliminated in many breeds of domesticated dog. (Fox, 1971:154)

Frank and Frank (1982) have confirmed many of Zimen's observations regarding the behavioral neotenization of domestic dogs and have contributed several interesting findings of their own. In their study, the development of the malamute and the wolf were carefully compared along several behavioral dimensions. Considerable differences between the two animals were observed in general activity and sleep-wake patterns, aggression and agonistic play, the degree of sexual dimorphism, ritualized aggression, and dominance ranking. Malamutes tended to lag developmentally behind wolf pups up until around 10 weeks of age, when the earlier motor differences disappear. Socially, the malamutes were found to be more outgoing and receptive to social contact with people than were the wolf pups. Unlike the malamutes, who actively solicited attention and contact with people, the wolf pups exhibited varying degrees of wariness, avoidance responding, and flight behavior from weeks 6 to 8 onward. In general, wolf pups exhibited a definite social preference for contact with other canids (in spite of having received greater amounts of direct socialization with human handlers), whereas the malamutes displayed a stronger preference for human contact than for canine contact. The malamutes also tended to be much more independent of the foster mother than were the wolf pups. Although the malamutes exhibited a friendly, deferential excitement toward the foster mother on her return after a brief period of separation, human handlers were met with an effusive and prolonged "greeting frenzy" not displayed otherwise.

The general activity level of malamutes during the first 6 weeks of life was much lower in comparison to that of wolves. The malamutes slept longer and more deeply than wolf puppies. The wolf pups engaged in more exploratory behavior of various kinds, ranging from "manipulating, dragging, chewing, stalking, shredding or carrying objects." An unexpected finding was the high degree of intense aggressive behavior exhibited by malamute puppies as early as 2 weeks of age and the delayed appearance of agonistic play until around week 4 or 5. Social interaction between wolf pups peaked around 8 weeks of age and then progressively declined, whereas such interaction steadily increased among malamutes through the age of 4 months. Active and passive submission behaviors were exhibited by the wolf pups during greeting rituals, begging displays, and play, but were not exhibited in response to dominance challenges by adults until after the pups were 12 weeks of age. Some sexually dimorphic tendencies were also evident in the behavior of

malamutes that were not exhibited by wolf pups. Female malamutes tended to be less aggressive, less socially assertive and demanding of attention, and less competitive over food and toys. Hart and Hart (1985) have noted a similar distribution of behavior along sexually dimorphic lines in a wide variety of domestic dog breeds.

Among several highly adaptive domestic features exhibited by the malamutes, the researchers found that the dog puppies were more fastidious and careful to avoid fecal material than were wolf pups. They speculate that unconscious selection pressures may have contributed to the malamute's high degree of cleanliness. The malamutes deposited their feces well away from their immediate nesting area from 32 days onward. Also, during feeding, the malamutes were more receptive to bottle nursing and accepted the transition to solid food more rapidly. An interesting feature distinguishing the malamute from wolf pups is the former's conspicuous appearance of immaturity and marked motor awkwardness in comparison with the wolf. As previously noted, the malamutes are more quiet and "peaceful" as puppies, spending more of their time sleeping or resting. The resultant image is one of helplessness and innocence: "In a sense, man has created the domestic pup in the image of an idealized infant" (Frank and Frank, 1982:515). The authors speculate that the prolongation of these qualities in domestic puppies facilitates greater attention, protection, and nutrition from their caretakers. An important feature of prolonged immaturity, vulnerability, and dependency is the establishment of a strong affectional bond between the "parent" and the animal, thereby forming a secure foundation for a lasting relationship along with many significant biological advantages. Interestingly, Frank and Frank (1982) note in this regard that the wolf foster mother showed a definite preference for the easier to manage and "cuter" malamutes. She washed them more frequently, spent much more time with them (two to three times as much), was more protective against intruders, exhibited more distress when separated from them, and played more often and longer with them than with the wolf pups.

Coppinger and associates (Coppinger et al., 1987; Coppinger and Schneider, 1996) have studied the effects of neoteny on the evolution of working dogs. They have argued against a trait-by-trait accumulation of breed characteristics in favor of a more generalized process of biological change. According to this theory, early selective pressures were focused more on general behavioral tendencies like tameness and utilitarian function than specific physical characteristics. Apparently, these early breeding efforts were guided by a "form follows function" philosophy. Only after the functional behavioral phenotype had been well established did breeding efforts turn to the refinement of appearances and conformation to type. These behavioral phenotypic changes were largely the result of neotenization. Typically, traits that are associated with tameness (playfulness, dependency, and care seeking) in adult domestic dogs are traits exhibited by juvenile and adolescent wolves. A factor of considerable importance in the process of neoteny is the timing of sexual maturity. There appears to be some linkage between precocious sexual maturity in dogs and the retardation of adult wolflike behavior patterns. An important result of early sexual maturation is the concordant appearance of loosely organized, playful patterns of behavior that resist articulation into phylogenetically functional motor sequences as expressed by adult wolves. These loosely organized neotenic behavioral patterns make domestic dogs much more receptive to training and socialization than are wolves. According to Coppinger's theory, working dogs (sled dogs, livestock-guarding dogs, and herding dogs) are distinguished by their relative degree of neoteny. For example, without the attenuation of aggressive tendencies and the simultaneous potentiation of a playful willingness to pull, sled dogs would not prove to be very effective workers. In the case of sheepdogs, livestock-guarding dogs must be protective but not aggressive toward the sheep in their care. Guarding dogs are considered to be more neotenous than herding dogs, who display some predatory elements like showing "eye," "stalking," and "chasing"—that is, more adult wolflike predatory traits. Although herding dogs exhibit preda-

tory motor sequences, they do not culminate in actual biting or killing.

THE SILVER FOX: A POSSIBLE MODEL OF DOMESTICATION

The process of behavioral and physical paedomorphosis has been observed experimentally in the selective breeding of silver foxes carried out by the Russian geneticist D. K. Belyaev and his associates at the Institute of Cytology and Genetics in Siberia (Trut, 1999). Belyaev (1979) speculated that the dog's early domestication proceeded "unconsciously" by selecting and breeding captive animals that exhibited a high tolerance for fear and a minimal tendency to behave aggressively toward humans. To test this hypothesis, Belyaev initiated a long-term genetics project in which foxes were selectively bred for tameness. The project has been ongoing for 40 years and has produced over 40,000 foxes. An important early finding was that ordinary farm-bred foxes exhibit a wide variability with regard to their response to human contact. He has estimated that approximately 30% of the farm-bred population is extremely aggressive, 20% fearful, and 40% aggressive-fearful, whereas the remaining 10% exhibit a quiet (neither fearful nor aggressive) exploratory behavior toward people. The foxes belonging to the quiet group are by no means tame or safe to handle, however.

The breeding program involved carefully selecting only those foxes that exhibited a prosocial "tame" response to human contact and handling. After fewer than 20 generations of selective breeding, tame foxes began to appear that exhibited striking physical and behavioral alterations in comparison to randomly bred counterparts (Fig. 1.6). Tame foxes are not only tolerant of human contact, they actively solicit and appear to enjoy social interaction with human handlers. Tame foxes engage in various doglike behaviors, including hand and face licking, solicitous jumping up, vigorous tail wagging, and excited vocalizations (e.g., barking)—all reminiscent of domestic dogs. The physical appearance of tame foxes has also undergone dramatic paedomorphic and doglike changes that include

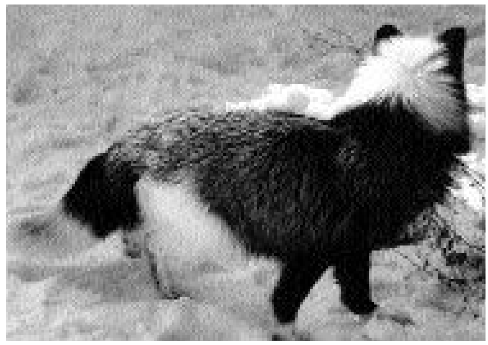

FIG. 1.6. Tame foxes are affectionate and invite contact with human handlers. Among several physical characteristics that distinguish tame foxes from farm-bred counterparts is a piebald pelage. (Photos courtesy L. N. Trut, Institute of Cytology and Genetics).

lop ears, a turned-up tail (a doglike characteristic not observed in wild foxes), and the development of piebald pelage. Such white spotting is commonly seen in a variety of domestic species and is highly correlated with tameness. Little (1920) has discussed the hereditary basis of piebald spotting in dogs, concluding that it may be a "mutational" change rather than a gradual one occurring as the result of selection pressures.

In addition to behavioral and morphological changes, Belyaev's tame foxes also underwent several concurrent physiological alterations. For instance, tame female foxes exhibit significant deviations from the norm in terms of their sexual readiness and behavior, becoming sexually receptive earlier in the year than is the custom among wild foxes. Endocrine studies have demonstrated that gonadal hormone activity in tame foxes is al-

tered, perhaps underlying and guiding the observed behavioral changes. As is commonly observed among most domestic dogs (but not wild ones), some tame foxes actually produce offspring twice a year. In spite of increased receptivity, however, as many as 30% to 40% of the females fail to reproduce successfully. Tame females either fail to actually produce offspring or display disturbances in maternal behavior, including a tendency to neglect their young or to kill and eat them (infantiphagia). Hediger (1955/1968) has noted similar degenerative effects in the maternal behavior of other domestic species. Another seasonal activity affected by domestication is molting. Tame foxes exhibit a protracted period of shedding—a destabilizing effect that may be genetically linked to the disruption of estrous cycles.

Several neurophysiological concomitants of domestication have been isolated in tame foxes. Belyaev's associates have found significant alterations of the relative reactivity of the hypothalamic-pituitary-adrenocortical (HPA) system of tame foxes in comparison to wild counterparts. By comparing the reactions of tame and wild foxes to emotionally provocative experiences, they have determined that the tame foxes are less reactive to stressful experiences than are wild ones. Also, interesting changes have been found in brain areas associated with the expression of emotion. Serotonin levels in the brain tissue of tame foxes are significantly higher than in wild counterparts. Popova and colleagues (1991) confirmed these early findings, having isolated significant alterations throughout the serotonergic system in the brains of domesticated foxes. Serotonin has been shown to be an important neuromodulator providing inhibitory regulation over stress-related behavior and aggression. Popova and colleagues have speculated that many of the behavioral and physiological changes (e.g., polyestrous tendency and reduced HPA system reactivity) observed in tame foxes may be causally linked with alterations in these serotonergic systems.

Selection for tameness among silver foxes has also produced changes in catecholaminergic systems. For example, tame foxes exhibit an increase of norepinephrine and dopamine activity in critical brain centers associated with the expression of defensive behavior. Dygalo and Kalinina (1994) have demonstrated a significant increase of tyrosine hydrolase activity in the brains of tame foxes in comparison to wild controls. Tyrosine hydrolase is the rate-limiting factor determining the amount of dopamine and norepinephrine that can be produced by the brain. The authors conclude that variations observed in the production of this essential enzyme is caused by a genetic alteration of the catecholaminergic system itself—a direct result of selective breeding for tameness. Similar comparisons have not been made between dogs and wolves. This line of research is of great importance for a better understanding of the mechanisms controlling defensive behavior at the neural level and may ultimately lead to productive insights into the etiology and management of canine aggression and fear-related behavior problems.

Selective Breeding, the Dog Fancy, and the Future

Whether consciously or unconsciously, selective breeding has been going on for many thousands of years, resulting in the genetic engineering of as many as 400 distinct dog breeds worldwide. Most of these breeds have been bred with some specific intention in mind, frequently a practical function like hunting, shepherding, and guarding. The earliest known breeds appear in the historical record around 3000 BP in Egypt. They are of a greyhound type and were probably specialized hunting hounds used for coursing game. The Assyrians had developed a much larger mastiff-type dog useful for hunting in dense cover.

Origins of Selective Breeding

According to Clutton-Brock (1984), the Romans were the first to breed dogs systematically on a large scale and to keep detailed records about the various breeds they kept. The Romans knew that selective breeding could affect physical appearance and behavior. By this time, all of the major breed types were well established (e.g., guard, hunting,

coursing, shepherd, and lap dogs) and it was recognized that training was needed to properly fit form to function. The Greeks had also applied themselves to the selective breeding of dogs long before the rise of the Romans. Already in Homer's *The Odyssey* (Fitzgerald, 1963) clear distinctions are made between working dogs and pets. In the famous dialogue between Odysseus and Eumaisos, the hero (concealing his true feelings at the moment in order to maintain his disguise) comments on the topic as he looks upon his dying dog:

> I marvel that they leave this hound to lie
> here on the dung pile;
> he would have been a fine dog, from the look of him,
> though I can't say as to his power and speed
> when he was young. You find the same good build
> in house dogs, table dogs landowners keep
> all for style. (1963:320)

Not only had the Greeks understood the importance of selective breeding at an early date, they had also recognized the danger of breeding that displaces function for the sake of appearances.

By the 5th century BC, various breeds had been developed for specific hunting tasks and purposes. Xenophon, a student of Socrates, wrote an important essay around 380 BC on hunting and hunting dogs, entitled *Cynegeticus* (1925/1984). The tract gives one a rare glimpse into the breeding and training of Greek hunting dogs. For hunting hare and driving the quarry into nets, the Castorian and vulpine breeds were favored. Deer hunting required bigger and stronger breeds like the Indian hounds (mastiff-type dogs). For wild-boar hunting, a variety of dogs were employed in a mixed pack, including the Indian, Cretan, Locrian, and Laconian breeds. The vulpine breed, as its name implies, was believed by Xenophon to be the result of crossbreeding a dog with a fox. Clearly, great care was taken to keep these breeds unadulterated. Xenophon describes the use of a wide surcingle (girth strap), apparently used to prevent undesirable matings:

> The straps of the surcingles should be broad, so as not to rub the flanks, and they should have little spurs sewed into them, to keep the breed pure. (1925/1984:401)

Merlin (1971) has speculated that another function of this piece of equipment was to protect dogs from injury when hunting dangerous game like wild boar.

In the *Republic*, Plato (1961) outlines a concise description of the selective breeding process:

> Tell me this, Glaucon. I see that you have in your house hunting dogs and a number of pedigreed cocks. Have you ever considered something about their unions and procreations?
>
> What? he said.
>
> In the first place, I said, among these themselves, although they are a select breed, do not some prove better than the rest?
>
> They do.
>
> Do you then breed from all indiscriminately, or are you careful to breed from the best?
>
> From the best.
>
> And, again, do you breed from the youngest or the oldest, or, so far as may be, from those in their prime.
>
> From those in their prime.
>
> And if they are not thus bred, you expect, do you not, that your birds' breed and hounds will greatly degenerate?
>
> I do, he said. (*Rep*, 5:459a)

Information about dog breeding in the remote past is scant and unreliable, but certainly strong selection pressures were at work over the course of the dog's domestication.

The rise of breeding for the sake of appearances alone is a relatively new phenomenon in the history of dogs, coinciding with the appearance of organized dog showing and efforts to standardize the various breeds. This new emphasis and interest appeared shortly after the banning of dog fighting and bull baiting in England in 1835—an event closely associated with the founding of the Royal Society for the Prevention of Cruelty to Animals in 1824. With the loss of these traditional forms of canine "entertainment," the public turned its attention toward other venues for the enjoyment of dogs.

These various cultural changes moved dogs out of the hands of the lower working classes and placed them (after a transition of "proper" breeding) on a "higher" social level. The Victorian bourgeoisie adopted the dog as a newfound status object with which they could proudly display their refined taste in the form of breeding and pedigree (Ritvo, 1986). Along with this preoccupation with status came an effort to standardize the various breeds—a process based largely on appearances, with an inevitable neglect of function. Unfortunately, it is hard to separate fact from fiction with regard to the history of these various breeds, since many of their historical origins appear to be fanciful 19th-century fabrications. According to Ritvo (1987), most of the modern breeds as they are recognized today are little more than 100 to 150 years old. She notes that even the early breed standards were written almost from scratch. This observation reflects the tremendous influence that the Victorian-era dog fancy had on the development of modern dogs, especially with respect to their appearance. Clearly, though, most of the common breeds associated with purebred dogs were already well established as working dogs prior to this time, as one can readily observe in V. Shaw's histories, descriptions, and engravings included in *The Illustrated Book of the Dog,* published as a serial between 1879 and 1881.

Of course, many efforts to breed for physical appearances had occurred long before the 19th century, but never to an extent comparable to the contemporary efforts involving so many diverse breeds. In China, for instance, the Pekingese was carefully managed under the protection and patronage of the Manchu emperors. The original stock was bred with an eye toward both form and function, producing a dog of exquisite beauty, vigor, and intelligence; these animals frequently lived full and healthy lives for up to 25 years, in spite of their genetically induced physical deformities (Tuan, 1984).

Undoubtedly, appearance has always played an important role in the selection process, but it was rightfully subordinated to the far more important goals embodied in utilitarian function, health, and temperament. Many experienced breeders have lamented the genetic fact that form and function rarely interact in felicitous proportions—good working dogs are more often than not "ugly" according to breed standards of beauty. With an eye set rigidly on the arbitrary appeal of appearances and beautiful form, the qualities of intelligence and function inevitably degrade over time. Konrad Lorenz expresses a similar conclusion in *Man Meets Dog*:

> It is a sad but undeniable fact that breeding to a strict standard of physical points is incompatible with breeding for mental qualities. Individuals which conform to both sets of requirements are so rare that they would not even supply a foundation for the further propagation of their breed. ... I know of no "champion" of any dog breed which I should ever wish to own myself. It is not that these two differently directed ideals are basically opposed to one another. It is hard to understand why a dog of perfect physique should not be endowed with equally desirable mental attributes—but each of the two ideals is, in itself, so rare that their combination in one and the same individual becomes a thing of the grossest improbability. (1954:93)

The first organized dog show took place during the summer of 1859 in Newcastle-upon-Tyne, England (Davis, 1970). By 1873, the British Kennel Club was organized to regulate the breeding and exhibition of purebred dogs. Shortly thereafter, the American Kennel Club (AKC) (1884) was formed in Philadelphia as the ruling body over affiliated breed clubs in the United States. The first organized dog show in the United States was sponsored by the Westminster Kennel Club in 1877. The original purpose of the AKC was stated to be the "protection and advancement" of purebred dogs, but many critics have questioned whether the AKC really has fulfilled these promises. Whatever deserving faults and shortcomings, without the organized international efforts of dog fanciers and organizations like the AKC, a great many currently well-established and flourishing breeds might have otherwise gone extinct over the past century.

Prospects for the Future

Breeding carried out under the stewardship of responsible breeders has undoubtedly resulted in the genetic improvement of dogs in the dual directions of appearance and performance—if not in health and biological fitness (see below). Unfortunately, dogs bred by such breeders are registered on an equal basis with dogs bred indiscriminately by dilettantes and uncaring pet merchants. With the advent of large shopping centers, multibreed pet stores followed, carrying a variety of breeds for sale under a single roof. The public setting of these stores took advantage of high foot traffic and the impulsive buying habits evoked by the sight of a lonely puppy curled up behind a window. To stock these stores with puppies in sufficient variety and quantity at the lowest possible prices, the store buyers sought inexpensive wholesale sources to meet a burgeoning market. This excluded established breeders since they are usually unwilling to deal with pet retailers, or since the cost of acquiring well-bred puppies would make resale only marginally profitable. Consequently, an "industry" of commercial puppy breeding erupted (mainly in the Midwestern section of the country) producing puppies in great numbers and frequently under appalling conditions with little regard for established breeding practices. Unfortunately, these "milled" puppies are accepted and certified as purebred by the same registry (the AKC) as are their most carefully selected and conscientiously bred counterparts. The pet stores benefit greatly from this arrangement since registered purebred puppies are worth considerably more money on the retail market than are puppies sold without "papers."

This general situation is aggravated by a large population of dogs produced by average breeders whose aspirations may not extend much beyond the opportunity to supplement the family income. These so-called "backyard breeders" often neglect temperament, function, and appearances altogether. Using newspaper classified ads as their primary means of marketing, they can avoid the stigma of being associated with a pet store—but their "product" is rarely much better in quality. Producing dogs in such a way is much less expensive than carefully breeding them for excellence of form, function, and health. Consequently, professional breeders are frequently faced with an unfair disadvantage. Breeding quality dogs is an expensive enterprise. Although securing a profit is secondary to a love of the breed, the lament of many dedicated breeders is that it is not possible under current conditions to breed quality dogs and also to survive as a business. Of course, a great number of dedicated and responsible breeders have survived, and their efforts help to keep things in check, but their numbers may be dwindling in a marketplace where it is hard for them to compete.

The incidence of genetic disease is increasing, and the prospects for the future are dim unless coordinated efforts are orchestrated toward the combined goals of education and professional responsibility in dog breeding. Several laudable efforts are under way that may eventually help to mollify the current situation. For many years, screening has been available for the detection of several genetically transmitted diseases, especially eye disorders and hip dysplasia. Certification by the Canine Eye Registration Foundation (CERF) and the Orthopedic Foundation for Animals (OFA) should be required of all breeding stock prone to the expression of such disorders. A potentially beneficial project has been developed by Jasper Rine at the University of California–Berkeley. Rine and associates have launched an effort to map the evolution of various dog breeds. A possible eventual application of the Dog Genome Project is the identification of the specific genes involved in the transmission of behavioral disorders and genetic diseases. Another dog genome project is being led by George Brewer at the University of Michigan where DNA diagnostics are being studied and developed into a private diagnostics company. An important project for tracking genetic disease is the Canine Genetic Disease Information System (CGDIS), a computer software package developed under the guidance of Donald Paterson at the University of Pennsylvania. Finally, the Institute for Genetic Disease Control in Animals at the University of California–Davis is an open registry for dogs and other animals with genetic disease. Unfortunately, the impact of

these tools will be evident only among responsible breeders (who are not the problem) and will not likely reach those who care nothing about the welfare of dogs and whose interest extends little beyond profitable merchandising of their AKC-registered purebred puppies.

There exists substantial disagreement with regard to the possible genetic transmission of temperament traits and behavioral disorders among dogs. However, mounting evidence suggests that some forms of dominance aggression are genetically transmitted. A possible case in point is the so-called "springer rage syndrome," or what may be more appropriately termed "low-threshold dominance aggression." Low-threshold dominance aggression is a behavioral disorder of the English springer spaniel that affects many otherwise loving and companionable dogs. Ilana Reisner at Cornell University (personal communication) has found evidence suggesting that this genetically transmitted behavioral predisposition may be traced to a single kennel. She is currently analyzing pedigrees and other statistical evidence from a large survey of Springer spaniel owners that may help to elucidate the exact mechanism of transmission more fully in the future. For now, however, the "popular sire effect" appears to be a highly plausible explanation. The popular sire effect occurs when a particularly desirable show dog is bred over and over again for some set of physical attributes, but who, in addition, may carry hidden in his genome an undesirable physical or behavioral trait that also gets haphazardly passed along in the gene pool as well. The opportunity for genetic disaster is particularly ominous in such cases. Given that a trait conducive to dominance aggression is traceable to a single kennel, one can reasonably infer that a small founder population (perhaps, even a single popular sire) is responsible for the trait's spread into the springer population. It is less likely that a "popular" dam acted as the primary catalyst, simply because of her limited reproductive potential.

Helmut Hemmer (1983/1990) has studied the genetic trend toward degeneracy and sensory disability in the dog. By comparing the sensory and behavioral abilities of the domestic dog with that of the wolf, Hemmer found that the dog has been "damaged" on many sensory and behavioral levels. In addition to the health costs associated with domestication, the dog's sensory abilities, along with many innate behavioral systems and mechanisms, have suffered under the pressure of artificial selection. The dog has experienced a general decline of what Hemmer has termed "environmental appreciation." Environmental appreciation refers to the sum input and organization of sensory information, that is, the animal's perceptual experience or gestalt. Various sensory mechanisms and underlying neural structures are involved, profoundly influencing the quality and intensity of the dog's perceptual experience. In short, domestication has narrowed the range and quality of the dog's senses, thereby adversely affecting the quality of its life.

While current breeding practices have undoubtedly contributed to the dog's contemporary decline in health and temperament, the effects of domestication—even when guided under the best intentions—are inherently degenerative with regard to the natural prototype being genetically modified to match human purposes. Clearly, the dog enjoys a biological advantage over its wild progenitor in terms of survival rate and raw numbers. But this reproductive success is at the cost of biological soundness and is fraught with dangers associated with overspecialization and close breeding, e.g., genetic drift and founder's effect. Over 400 genetic diseases have been isolated in the dog with about 10 new ones being described each year (Smith, 1994). The degenerative effects of domestication are a natural outcome of the dog's "protected" status, and may not be entirely attributable to breeding practices alone. Unlike wild canids, the dog's biological success or failure is not dependent on "fitness" in the broad sense demanded by nature, but by an arbitrary set of demands related to a narrow ecological niche in cohabitation with man's. Darwin reflected on these various dangers associated with domestication:

> It can, also, be clearly shown that man, without any intention or thought of improving the breed, by preserving in each successive genera-

> tion the individuals which he prizes most, and by destroying the worthless individuals, slowly, though surely, induces great changes. As the will of man thus comes into play we can understand how it is that domestic races of animals and cultivated plants often exhibit an abnormal character, as compared with natural species; for they have been modified not for their own benefit, but for that of man. (1875/1988:3)

The most important lesson to be learned from these trends is that breeding must be carried out with great care and attention to the whole dog, not just the way it looks.

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2

Development of Behavior

Organization is inseparable from adaptation: They are two complementary processes of a single mechanism, the first being the internal aspect of the cycle of which adaptation constitutes the external aspect.

J. PIAGET, *The Origins of Intelligence in Children* (1952)

DOG BEHAVIOR is determined by many interdependent biological and experiential factors. Although dogs are biologically prepared to develop in specific ways and to exhibit a limited set of potential traits and behavior patterns, the expression of these tendencies is flexible and subject to the general laws of learning. Even this adaptive *variability*, though, is ultimately limited by biological constraints. Besides the influence of genes and their biological expression, behavior is guided and modified by the influence of experience. The actualizing effect of the environment interacting with an animal's genetic potential or genotype yields its unique physical and behavioral phenotype. In contrast to the genotype, which remains outside the direct influence of learning, the phenotype results from the actualizing influences of the surrounding environment interfacing with the biologically mediated genome. These environmental circumstances can exercise either a beneficial or a destructive influence over the course of a puppy's development. General adaptation is continuously refined or rendered progressively dysfunctional depending on the type of experiences involved. Every moment offers the potential for constructive learning and adaptation or the reverse, especially in the case of an impressionable puppy.

If the environment provides a puppy with insufficient or inadequate experience for the development of a particular behavioral system, the innate behavior patterns and tendencies expressed by that system will atrophy or develop abnormally. The behavioral organization of the dog is a complex unity wherein various components are hierarchically integrated with one another at various levels. The proper functioning of one system of behavior depends on the support and adequate functioning of other systems. Early experiences are particularly influential in this

regard. Puppies provided with poor socialization or deprived of environmental exposure often develop lifelong deficits and dysfunctional behaviors. A puppy isolated early in life from other puppies and humans will not only fail to establish satisfying social contact with conspecifics or enjoy companionship with people later in life (such puppies are extremely fearful of any social contact), they will also exhibit widespread behavioral and cognitive disabilities, as well. Isolated puppies exhibit poor learning and problem-solving abilities and are extremely hyperactive or rigidly inhibited, are emotionally overreactive and unable to encounter novel social or environmental situations without extreme fear and avoidance, and are socially and sexually incapacitated. Nearly every behavioral system is adversely affected, leaving the puppy encased within an autistic shell of fear, insular despair, and perpetual confusion.

The foregoing scenario is extreme and rarely observed outside the laboratory, but it does underscore the importance of early experience on the development of dog behavior. Although the vast majority of puppies are not exposed to such complete isolation, many do incur varying degrees of early social and environmental deprivation. Puppies bred under careless conditions where they are reared like livestock by irresponsible and ignorant breeders are topical cases in point. Such puppies are often exposed to the most appalling conditions and cruel treatment. When they come into homes, they are already heavily burdened, exhibiting many of the following conditions: patterns of extreme hyperactivity, intense precocious aggressiveness, and fearfulness toward humans and other dogs. They are often prone to separation anxiety, orally fixated (focusing on personal belongings as well as hands), coprophagous, and they are frequently difficult to house train. With supportive training involving intense remedial socialization, graduated environmental exposure, and endless patience, such puppies can regain some degree of composure and develop into reasonably well-adjusted companion dogs. Even after undergoing the best training available, though, such puppies will never reach their full potential.

Responsible breeders provide their puppies with daily environmental enrichment and preliminary training, including ample social experiences and constructive activities (e.g., house training), that prepare them for an easy transition into their future homes (Monks of New Skete, 1991). Experienced breeders can detect, through a keen eye and various temperament tests, the general emotional disposition of their puppies and thereby place individual puppies in homes consistent with their respective needs. Puppy temperament tests should not be employed to predict adult aptitudes or the potential exhibition of adult behavior patterns but should be used as tools to isolate and quantify a puppy's various strengths and weaknesses at the time of testing. Many behavioral indexes associated with temperament evaluation are flexible and subject to change during a puppy's development (Scott and Fuller, 1965), making temperament tests indicative rather than predictive. Puppy tests are excellent tools for evaluating training progress and for objectively assessing areas that may need additional remedial work. Finally, professional breeders should provide their clients with an information packet covering puppy care and basic training, as well as phone numbers for trainers, obedience clubs, and other relevant support professionals. Most breeders are dedicated to their breed and are willing to share their knowledge and valuable experience to help a new puppy owner through those challenging first few weeks of intensive training and care. Ideally, a breeder and a trainer should work together as a team helping an ill-prepared owner through the sometimes onerous vicissitudes of puppy rearing and training.

Learning plays a significant role in the development of puppies. Understanding how learning impacts development is an important first step in the study of dog behavior. The most influential research on this topic was carried out at the Jackson Laboratory in Bar Harbor, Maine, under the supervision of J. P. Scott and J. L. Fuller. These pioneering efforts paved the way to a fuller understanding of the general processes of ontogeny and, in particular, the development of social behavior. A central purpose of this work was to

evaluate the extent and differential influence of genetic versus experiential factors on the development of behavior. With this goal in mind, they chose dogs from several distinct breeds possessing differing attributes and behavioral tendencies, and then experimentally studied their reactions to various environmental manipulations and stressors. Their study clearly demonstrates that different breeds exhibit specific inherited strengths and weaknesses when coping with environmental pressures. However, the most important result of their study was the discovery of several critical or sensitive periods for the social development of dogs. Their work was reported in a seminal text for breeders and trainers entitled the *Genetics and the Social Behavior of the Dog* (1965). Another important source of information regarding the development of puppies (especially neonatal and transitional processes) needs to be credited to the valuable work of Michael Fox. He is the author of many texts, but the most noteworthy in this regard is *Integrative Development of Brain and Behavior in the Dog* (1971).

The Critical or Sensitive Period Hypothesis

During development and growth, dogs undergo a process of progressive biological organization and simultaneous behavioral differentiation. This ontogenesis is marked by several more or less distinct sensitive or critical periods for the development of various psychosocial functions. The onset and offset of these stages of development are biologically defined, making the animal susceptible to the crucial experience or its absence for a limited period. Within these sensitive stages, a short *optimal period* appears to occur during which appropriate stimulus contacts and experience are rendered maximally effective and beneficial to developing dogs. Scott (1962, 1968a) has argued that the critical periods of social development are defined by irreversible organizing processes reflected in growth and emerging behavioral complexity. Any system that has become well organized and stable is naturally more difficult to reorganize—that is, "organization inhibits reorganization" (Scott, 1962), unless, of course, the system in question is organized to be flexible to reorganization. According to Scott's hypothesis, behavioral organization can be modified only while it is under the active influence of the original processes of organization, that is, during susceptible critical periods for such activity and change occurring early in an animal's life.

One of the most important functions of the critical period is the formation of social attachments and bonding (Scott, 1968a). In dogs, primary socialization begins around 3 weeks of age. Before week 3, the mother is the puppy's primary social object. With the onset of the socialization period, she begins to leave the litter alone to fend for themselves for longer periods. The result is increased social bonding and attachment between littermates, and the formation of a protopack organization anticipating more adult patterns of canine social behavior (Scott, 1958). These social imprinting effects have received a great deal of experimental attention in a variety of animal species (Sluckin, 1965; Hess, 1973).

Many other behavioral tendencies and appetites are *imprinted* at an early age in puppies. Marr (1964) has found that puppies (3 to 4 weeks of age) can be strongly imprinted to a simple visual stimulus (a white circle against a dark background) by associating its presentation with varied stimulation, like flashing lights and rocking. Stimulated puppies (petted, rocked, or flashed) spent significantly longer time on the platform in contact with the visual stimulus than did controls, suggesting enhanced approach and *attachment* to the stimulus object as the result of varied stimulation. Some sort of learning obviously has taken place, but it is not conclusively an imprinting process. Marr's results could just as easily be interpreted in terms of other learning paradigms, like classical or instrumental conditioning.

Besides the formation of enduring attachments with people, dogs can also form strong interspecific attachments with other animals through imprinting or imprinting-like processes. Cairns and Werboff (1972), who carried out an experiment to investigate social attachment in 4-week-old puppies that had

been exposed to sustained contact with adult rabbits, found that puppies housed with rabbits quickly developed social attachments with their cohabitants and exhibited a lasting preference for contact with them. These changes occurred after a very brief period of exposure (within 24 hours of cohabitation). When separated from their rabbit cohabitants, the puppies emitted intense distress vocalizations and escape efforts aimed at regaining contact with the removed rabbits—behaviors consistent with separation-distress reactions exhibited as the result of the loss of contact with conspecifics. Similarly, Fox (1971) reared Chihuahua puppies from 25 days to 16 weeks of age with kittens and a mother cat. Cat-reared puppies displayed a strong preference for kittens over contact with other puppies. The controls (reared with other puppies) exhibited a sustained and active interest (with tail wagging) in viewing their reflection in a mirror located in the testing area. In contrast, cat-reared puppies spent much less time in contact with the mirror. After reaching 16 weeks of age, the cat-reared puppies were once again reunited with conspecifics and subsequently underwent 2 weeks of remedial socialization. Testing found that the cat-reared puppies had recovered most of their species-specific behavior patterns, demonstrating that the socialization effect is to some extent reversible. Also, cat-reared puppies exhibited a pronounced new interest in the mirror, as suggested by increased vocalization scores, activity levels, frequency of contact, and duration of contact with the mirror. During earlier observations, no sustained contact or tail wagging was observed in the presence of the mirror. Following the 2-week period of remedial socialization, however, the cat-reared puppies repeatedly approached the mirror, wagged their tails, and even sat looking at themselves in the mirror—sometimes pushing against it with their nose. Fox speculates that the cat-reared puppies were previously unresponsive to their reflection in the mirror because they lacked the necessary socializing influences needed to form an adequate species identity with which to recognize themselves:

> These observations lead to the conclusion that socialization influences the development of species and self-identity. Cat-raised dogs, having had no experience with their own species, were consequently nonreactive to their own reflections, but became more reactive as they were subsequently socialized with their own species. (1971:259)

In other studies, dogs have served as objects of attachment and imprinting involving species other than humans. Mason and Kenney (1974) found evidence among rhesus monkeys that the socialization effect was not irreversible. Monkeys reared under various social conditions were exposed at different ages to cohabitation with spayed female dogs. All the monkeys exhibited a pronounced initial fear of the dogs but quickly recovered with the aid of a series of graduated exposures carried out by the experimenters. Within several hours, most of the monkeys approached and began to cling to the receptive dogs. Both the monkeys and the dogs made frequent contact, played together, exhibited care-seeking and caregiving interaction (mutual grooming and anogenital licking), rested together, and exhibited every sign of enjoying each other's companionship. When separated from their dog companions, the monkeys exhibited separation-induced pacing, distress vocalization, and escape behavior—just as they would if separated from conspecifics with whom they had been socialized and attached. Similar cross-species attachment behavior and attachment reversal (upon resocialization with conspecifics) has been exhibited by lambs reared in cohabitation with adult female dogs (Cairns and Johnson, 1965).

A practical application of cross-species socialization is found among livestock-guarding dogs. Breeds like the Anatolian shepherd, the shar planinetz, komondor, and maremma have a long Eurasian tradition in the performance of this important shepherding task. From early in the socialization period, these dogs are reared with sheep and fed on ewe's milk. Such dogs form a strong social affiliation with sheep—an affiliation that inclines the dogs to protect their adopted species from predators and human intruders alike. Efforts have been under way for some years

now to introduce livestock-guarding dogs for the protection of sheep against the predation of coyotes and wolves in many areas of the United States (Coppinger and Coppinger, 1982).

Early Development and Reflexive Behavior

The ontogeny of a dog's social behavior unfolds according to a genetically programmed timetable (Scott and Fuller, 1965; Fox, 1971). These early developmental processes exercise an enduring influence over the behavioral adjustment of dogs. During a brief period from 3 to 16 weeks of age, an average puppy will probably learn more than during the remaining course of its lifetime, forming a lasting emotional and cognitive schemata of the social and physical environment. Furthermore, these early experiences format the general outline and organization of how and what the dog is prepared to experience and learn in the future. It therefore behooves conscientious breeders and puppy owners to gain a working understanding of these developmental processes and the various methods used to influence them in the most efficient and beneficial ways. A puppy's early development is divided into four more or less well-defined periods: the neonatal period (birth to 12 days), the transitional period (12 to 21 days), the socialization period (21 to 84 days), and the juvenile period (84 days through sexual maturity).

Neonatal Period (Birth to 12 Days)

Just before birth, hormonal changes occur that cause puppies to undergo sexual dimorphism. Male puppies are exposed to a surge of testosterone, forming the foundation for malelike behavior later in life. Prenatal androgen secretions are believed to play a role in the formation of hardwired neural tracts associated with maleness. Some evidence suggests that female puppies may be affected by this androgenizing effect as well (Knol and Egberink-Alink, 1989). Female mice embryos located between males in the uterus appear to be influenced by the presence of vagrant testosterone carried in amniotic fluids, although it is not certain whether such a hypothesized osmotic mechanism is involved. Perhaps a similar effect holds for female dogs, but this possible hormonal influence has yet to be shown experimentally. The influence of cross-sexual prenatal androgenization may help to explain the display of malelike behavioral tendencies (e.g., male-directed aggression and leg-lifting behavior) by some female dogs. Another potential neuroendocrine influence on prenatal development involves the mother's emotional state (Thompson, 1957). If gestating rats are exposed to intense fear-eliciting stimulation, the resulting offspring are unstable and more emotionally reactive than controls gestated without such exposure.

A puppy is born within an allantoic sac and attached to the mother by an umbilical cord (Fig. 2.1). The cord is chewed through, the placenta removed and eaten, and the puppy thoroughly licked clean and dried. Besides cleaning the puppy, the mother's licking stimulates reflexive muscular movements and breathing. At birth, a puppy is unable to control its body temperature and is very sensitive to changes in ambient temperature. A near-constant temperature is maintained by its keeping in close physical contact with the mother and littermates. However, a puppy that becomes too warm will move away to maintain an optimal temperature (Welker, 1959). The neonate exhibits intense distress vocalizations when separated from littermates and placed on a cold surface. Fredericson and colleagues (1956) proved that such distress was not due to loss of contact comfort but the result of temperature changes experienced by the puppy. They found that neonates placed on heating pads were content and able to go to sleep without maternal or sibling contact. Dunbar and colleagues (1981) observed that a mother will readily retrieve distressed offspring that have become separated from the litter group through the first 5 days but after that will stop doing so.

From a neurological and sensory perspective, newborn puppies are both deaf and blind and thus virtually insulated from the external world. However, many primitive sensory and behavioral systems and reflexes are present at birth that assist puppies in nursing

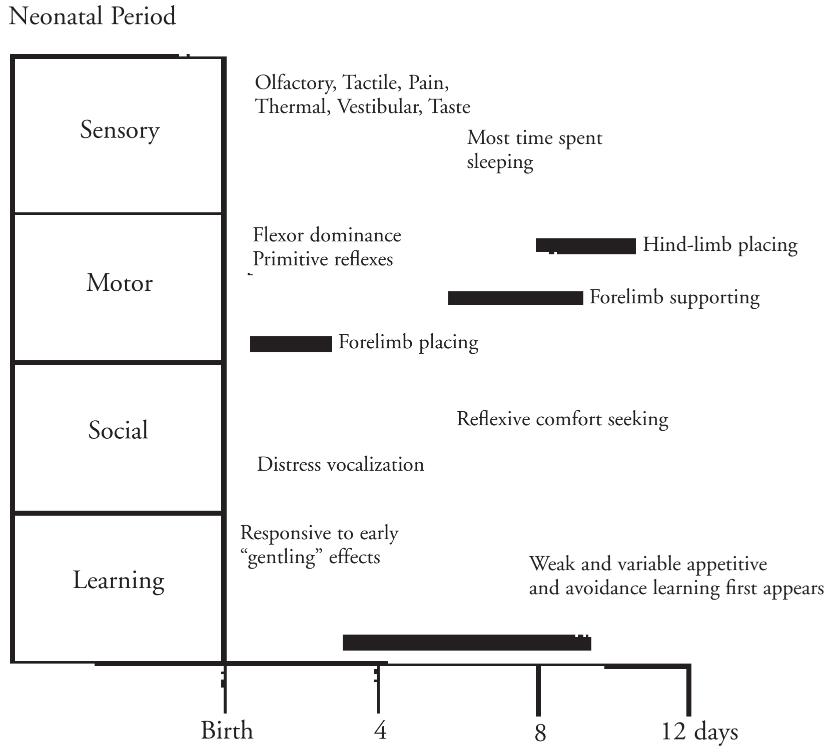

FIG. 2.1. The neonatal period is associated with reflexive activities aimed at optimizing nurturance and contact with the mother.

and keeping in contact with the mother (Table 2.1). Among these sensory capacities are sensitivities to pressure, movement, taste, and smell. Withdrawal from painful stimulation can be seen shortly after birth. Some forms of neonatal learning have been observed in the laboratory. For instance, Fox (1971) found that if the breasts of a nursing mother are coated with anise oil during the first 5 days of feeding, the exposed puppies subsequently exhibit an orienting response to a Q-tip soaked in the oil. On the other hand, puppies not previously exposed to the smell of anise oil on their mother's breasts exhibited a strong withdrawal response from it when similarly tested. This experiment indicates that some form of rudimentary learning is present in the neonatal puppies—a topic that is discussed in greater detail later in this chapter.

Most of a neonatal puppy's time is spent sleeping, with the remaining time devoted to nursing. When sleeping, a puppy exhibits extensive twitching and nervous movements over its entire body. Electroencephalogram (EEG) studies have demonstrated that waking and sleeping states exhibit nearly identical patterns of low brain activity (Fox, 1963). Urination and defecation must be elicited by the mother for the first 2 weeks or so by rhythmically licking the anogenital area. Such licking usually occurs just prior to feeding, serving to both wake the puppy for nursing and to elicit elimination (Grant, 1986). A puppy's general motor activities at this stage of development are limited to swimlike crawling movements predominately involving the front legs. Guided by tactile, olfactory, and gustatory senses, a puppy reflexively orients and locates the mother's teat. Forelimb-placing movements are seen after 2 or 3 days, and efforts at forelimb support begin between days 6 and 10. Hind-limb-placing responses are seen after 8 days. Flexor muscles are dom-

TABLE 2.1. Reflexive behavior observed in neonatal puppies

Neonatal Reflexes	S	R
Magnus	Elicited by turning the neonate's head to one side	The action causes an extension of the forelimbs and hind limbs on the side toward which the head is turned. Limbs on the opposite side tend to flex.
Crossed extensor	Elicited by pinching the webbing of the hind foot	The leg on the side pinched flexes while the opposite leg extends.
Negative geotactic	The puppy is placed on a surface that is tilted up.	The puppy reorients by twisting in the direction of the elevated side.
Rooting	The hand is cupped around the puppy's muzzle.	Forward movement is elicited as long as the puppy maintains contact.
Photomotor	A bright light is flashed into the closed eye of the puppy.	A blink is elicited; not operative until day 2 or 3.
Reflexive elimination	Elicited by gently dabbing ano-genital area with a wet cotton ball	Reflexive urination and defecation

Source: After Fox (1971).

inant over extensors for the first few days, followed by a much longer period of extensor dominance and the emergence of unsteady walking in the transitional period. Nonnutritive sucking actions can be elicited early in the neonatal period, with a peak occurring around days 3 to 5 and gradually declining over the first 3 weeks. Early forced weaning causes a distortion in this pattern, causing puppies to suck much more actively on fingers or sometimes on littermates (Scott et al., 1959). Scott and colleagues (1959) observed that, among 500 puppies that were left with their mothers through 10 weeks of age, none exhibited the body-sucking habit exhibited by prematurely weaned counterparts. Puppies that are weaned too early (before day 15) may be prone to develop adult oral and motor compulsions involving sucking and kneading directed toward blankets and other soft objects.

Although neonatal puppies are developmentally insulated from the environment, some external influences may have long-term effects on learning, emotionality, and general adaptability. Early neonatal handling involving as little as 3 minutes a day and exposure to various mild environmental stressors, like changes of ambient temperature and movement (gentling), may have positive impacts on a puppy's resistance to disease, emotional reactivity, and mature learning and problem-solving abilities (Morton, 1968). Denenberg (1964), who has reviewed a considerable body of literature regarding neonatal stimulation and its effect on adult emotionality in rats, concludes that the degree of adult emotionality exhibited by the animal is conversely proportional to the amount of infantile stimulation experienced prior to weaning (Fig. 2.2). Animals left undisturbed during neonatal development were found to be consistently more emotionally reactive as adults. Levine and colleagues (1967) exposed rats to an early differential handling/stress regimen in which an experimental group was removed from the litter and placed in a can with shavings for 3 minutes per day for the first 20 days of life. The control group was composed of animals left undisturbed during the same period. Once mature (80 days), the rats were exposed to an open-field situation, a test that reveals general reactivity and fearfulness. The behavior of the two groups was observed, especially general activity and defecation frequency, and all the animals tested were subsequently evaluated in terms of adrenocortical response. Previously handled rats were found

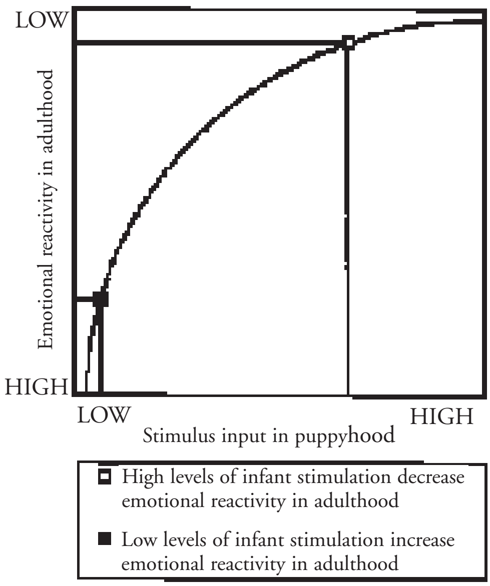

FIG. 2.2. Hypothesized curve correlating the relative amount of early stimulation and the degree of emotional reactivity observed in the adult. After Denenberg (1964:341).

to be more active and defecated less than controls during testing, suggesting that they were less fearful and inhibited under the novel conditions. Handled animals also appeared to habituate more quickly to the test situation over several days of evaluation, rendering them more adaptable than controls. Nonhandled animals consistently exhibited higher levels of corticosteroids than handled ones, further confirming the latter's lower stress reactivity under the conditions of the test.

In other experiments performed by Levine (1960), handled rats exhibited a more precise and adaptive adrenocortical response pattern when exposed to stress induced by shock. Although both handled and nonhandled rats exhibited similar blood levels of adrenal steroids before stimulation, the handled rats showed a much higher level within the first 15 minutes following shock than the nonhandled group. The nonhandled group, though achieving the same blood levels eventually, did so only after a long poststimulation delay. Further, steroid levels in the nonhandled group were maintained at a higher level over a much longer period than in the handled group. According to Levine, the fast hypothalamic-pituitary-adrenal (HPA) system response in the handled animals is more consistent with the proper functioning of the animal's emergency-stress system. During stress activation, an animal's emergency resources should be fully mobilized in the moment when they are needed most, followed by a rapid decline and denouement phase. As noted above, the nonhandled animals tended to react slowly to aversive stimulation with a prolongation of the stress reaction. This physiological response to stress exhibited by nonhandled animals may eventually result in various psychosomatic effects: stomach ulcers, immunosuppression, and sometimes death from adrenal exhaustion.

The aforementioned research suggests that early handling exercises a lasting influence on the activity of the HPA system. These influences include autonomic changes as reflected in reduced emotionality and increased stability. It is, therefore, possible that early handling may exercise a potentially pronounced effect on the animal's basic temperament and future trainability.

Fox and Stelzner (1966) performed a series of experiments with puppies from birth to 5 weeks of age to evaluate the effects of early handling on development. The puppies were exposed to various stimulus extremes, including cold, flashing lights, noises, and vestibular stimulation (rocking on a tilting board). The results indicate that the stressed puppies performed better in problem solving (perhaps because of reduced emotional reactivity) and were socially dominant over controls not exposed to the earlier stress-inducing experiences. Several physiological concomitants were also observed. Stressed puppies exhibited a precocious EEG pattern, produced five times more adrenal norepinephrine, and displayed a heart rate indicative of stronger sympathetic tone. A practical application of early handling stress was carried out by the U.S. Army's Superdog Program (Biosensor). Immature puppies were exposed to slow, refrigerated centrifuging to produce handling stress. To my knowledge, no published studies have been written concerning these experiments, and the potential

benefits of such treatment remains conjectural, although anecdotal reports indicate "extremely promising results in terms of later stress—resistance, emotional stability, and improved learning ability" (Fox, 1978:165). Some amount of handling stress should be part of a breeder's normal rearing practice to compensate for the absence of naturally occurring stressful changes in the whelping area. Conditions in the average kennel may be too artificial, insular, and protective for optimal psychological and physical development. Not all research findings uniformly support the belief that early exposure to stress is beneficial. For example, recent research involving rats reported by Nemeroff (1998) suggests that the distress evoked by briefly separating rat pups from their mother and littermates is sufficient to exert permanent adverse effects over neural circuits mediating stress reactivity and emotional arousal (see Chapter 3 for discussion). Consequently, there may be developmental periods when stressful exposure is particularly beneficial and others (e.g., early in the socialization period) during which small amounts of stress may produce pronounced and lasting detrimental results.

Although neonatal learning abilities are limited by the range of a puppy's sensory abilities, conditioned appetitive and avoidance responses have been established between days 3 and 10. For example, Stanley and colleagues (1963) conditioned neonates to respond differentially with increased approach and sucking or repulsion and avoidance of sucking depending on whether milk or a quinine solution was presented through an artificial nipple. Stable escape-avoidance responses toward cold-air stimulation have also been achieved. Stanley and colleagues (1974) placed neonates in a plastic tub with one side covered with cloth while leaving the other side exposed plastic. Neonates were placed on the cloth side and stimulated with a flow of cold air directed onto their shoulders. Tested puppies readily escaped stimulation by moving away from the cold air and crossing into the safety of the uncovered side of the plastic tub. Subsequent tests demonstrated that the puppies responded to the cloth side as an avoidance stimulus causing them to move into the plastic side of the tub, apparently anticipating and avoiding the presentation of the cold-air stimulus. Stanley and coworkers (1970) also demonstrated that neonates can readily learn a simple discrimination task involving approach to cloth versus wire tactile stimuli, depending on whether the respective substrates provided milk. A subsequent study (Bacon and Stanley, 1970) demonstrated that these tactile substrate discriminations could be reversed (making the positive stimulus negative and vice versa). Furthermore, they found that the ability to learn such reversals improved with experience, suggesting that the puppies might be acquiring a learning set or "learning to learn." The foregoing results led the investigators to conclude that neonatal learning, though functionally limited, follows a pattern not dissimilar to the learning of adult dogs.

Developmentally, neonatal puppies move rapidly from primitive "vegetative" functioning to more complex modes of seeking-avoiding behavior. Determining how this process proceeds is an important ontogenetic problem. Schneirla (1959) has proposed that this process includes two interwoven ontogenetic phases involving approach-withdrawal (A-W) behavior. Early neonatal A-W behavior is differentially evoked depending on the intensity of the eliciting stimulus. Low-intensity (weak) stimulation tends to elicit approach behavior, whereas high-intensity (strong) stimulation elicits withdrawal. As puppies develop, these earlier patterns of responding are further elaborated into more complex and informative types of responding to environmental stimulation. Approach behavior becomes *seeking* or, in the terminology of learning theory, positively reinforced behavior and withdrawal behavior become *escape and avoidance* or negatively reinforced behavior. These two broad categories form the foundation of instrumental learning in dogs.

Of particular interest in this regard is the suggestion by Schneirla (1965) that approach behavior (relaxed-preparatory activity) is mediated by parasympathetic processes while interruptive withdrawal behavior (reactive-protective activity) is mediated by sympathetic processes. A-W stimulation during these early weeks may facilitate the differential "tuning"

of the autonomic nervous system in the opposing directions of relaxed parasympathetic dominance or, conversely, toward reactive sympathetic dominance. The sensory and motor abilities of neonatal puppies are ontogenetically organized to facilitate appropriate A-W behavior, thus ensuring the adequate procurement of nurturance and warmth. Neonatal comfort seeking is mediated by parasympathetic arousal, including various appetitive reactions like salivation, increased production of digestive juices, intestinal peristalsis, and generalized relaxation associated with normal respiration and heart rate. Maternal caregiving and *contact comfort* facilitates both digestion and emotional attachment (Fox, 1978). Without such comfort contact and the parasympathetic stimulation that it provides, normal digestive functions and growth patterns are disrupted. Protective sympathetic reactions, on the other hand, momentarily interrupt such appetitive functions and prepare the animal for emergency action.

According to Rosenblatt (1983), the transition from A-W reactions based on stimulus intensity to more mature seeking-avoiding behavior is mediated by the modality of smell. He has argued that olfaction provides the foundation for a higher order of response organization and stimulus meaning. Earlier A-W reactions mediated by tactile and thermal stimulation, for example, are identified by odor via associative learning (contiguity) mechanisms. Such olfactory stimuli become the fundamental positive and negative incentives that neonatal puppies seek or avoid as determined by prior experience with these stimuli. Although olfaction mediates some innate (or prenatally acquired) A-W behavior toward a few odors, Rosenblatt argues that the vast majority of olfactory incentives are acquired through learning. Sensory development can be viewed as progressing from stimulation requiring direct bodily contact with the evoking stimulus (touch) to thermal orientation (stimulus gradient from cold to warm) to odors that enable a broader environmental purview and a sufficient distance from which vantage to identify and anticipate significant events. As puppies develop, this ability to scan the environment for significance and, then, to precisely localize significant events occurring at remote distances sharply improves with the appearance of functional sight and hearing.

Although neonatal puppies are capable of learning, these abilities are confined to the association of primitive stimulus events and adjustment responses. The reason for this limited ability is due (among other things) to the absence of myelinization in the neonatal brain. At birth, the only nerve tracts possessing significant myelin sheathing are those associated with taste and sucking. Also, at birth, there are evidently olfactory abilities present that become progressively developed through the neonatal and transitional period. The behavior of neonatal puppies is mainly composed of unconditioned reflexes adaptively organized to ensure adequate warmth, nutrition, elimination, and general survival needs. Most of these "vegetative" reflexes become progressively variable as puppies develop, and disappear before the onset of the socialization period (Fox, 1964a; Markwell and Thorne, 1987).

Transitional Period (12 to 21 Days)

The transitional period is marked by progressive neurological development with steady improvement in locomotor ability, the appearance of additional sensory modalities (including the opening of the eyes and ear canals), and the development of greater central control over voluntary behavior (Fig. 2.3). The righting and visual cliff reflexes appear during this period, but they are not consistent until approximately 28 days of age (Fox, 1971). Throughout this period, the behavior of puppies becomes progressively more active and independent of the influence of neonatal reflexes (Fig. 2.4). As the eyes open, puppies begin to crawl backward. Hind-limb supporting reactions are weak, and variable responses appear between 11 to 15 days of age. A puppy can support itself on all four limbs and walk unsteadily as early as day 12. Early walking efforts are poorly coordinated and associated with bobbing of the head

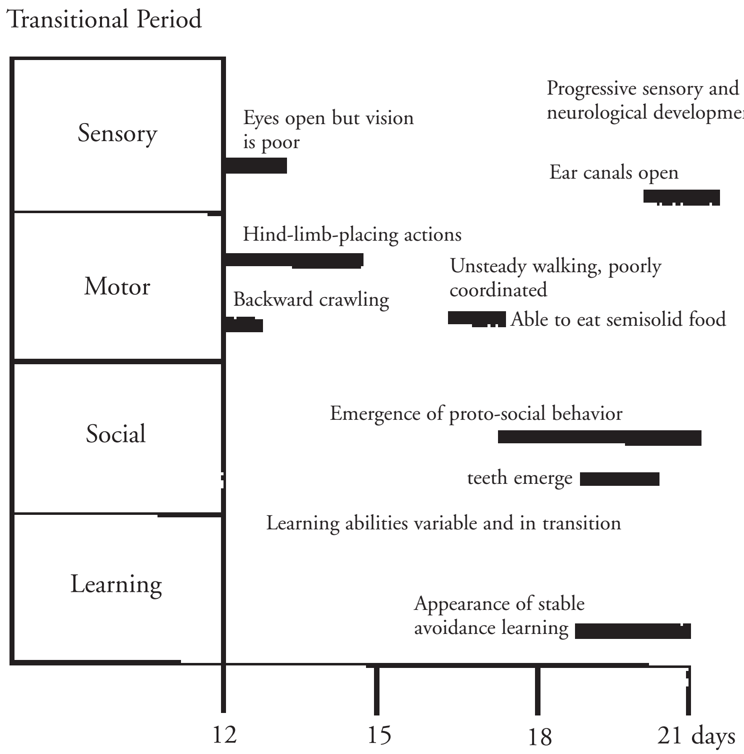

FIG. 2.3. The transitional period is associated with progressive motor and sensory development.

from side to side. As flexor-extensor balance improves, this side-to-side movement of the head disappears.

If necessary, puppies can be weaned and taught to eat gruel as early as day 16. The teeth begin to emerge late in this period. Although puppies can now eliminate voluntarily, Grant (1986) did not observe evidence of independent elimination in puppies during the 20 days of his study.

The transitional period is characterized by tremendous change and development. It is during this time that puppies begin to leave the cocoonlike protection of neonatal existence and emerge into a field of widening sensory experience. Although nursing is of great importance to puppies, an independent desire for contact comfort is also evident during this period. Igel and Calvin (1960) carried out a series of experiments with puppies between 11 to 30 days of age to determine a puppy's relative interest in nursing versus simple contact comfort. Their study duplicated an earlier experiment performed by Harlow and Zimmerman (1959) in which infant monkeys were shown to exhibit a preference for nonnutritive cloth surrogate mothers over wire "lactating" ones. Although nursing remains an important activity, the maintenance of contact comfort is of growing significance to developing puppies. The authors found that puppies spent considerably more time with nonnutritive cloth mothers than with wire surrogates that provided milk. Interestingly, the puppies exhibited a growing preference for close contact with the nonnutritive cloth mother as they grew older, suggesting the existence of an underlying developmental process mediating social bonding.

Stanley and colleagues (1970) found that neonatal puppies (2 to 7 days old) also exhibit a very strong preference for soft sub-

Neonatal and Transitional Reflexes

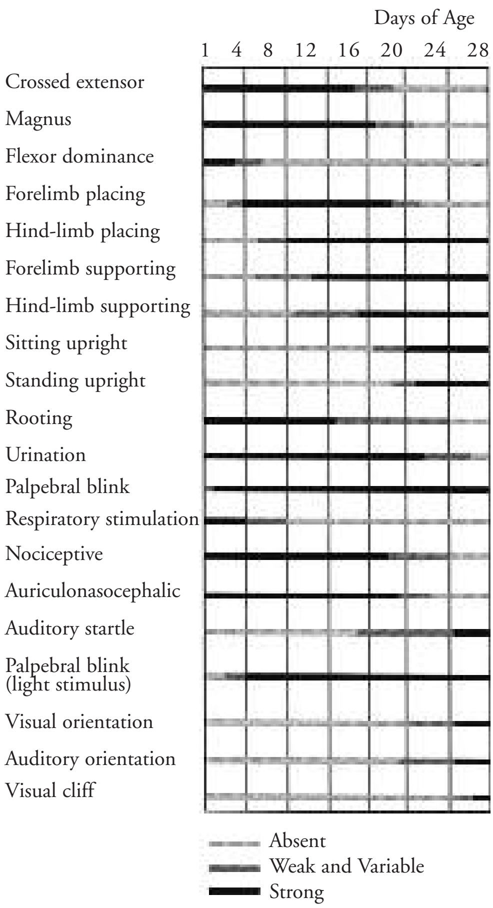

FIG. 2.4. Showing the developmental changes of reflexive behavior in the puppy. After Fox (1971).

strates over wire ones. Although the neonates exhibited an initial preference for the cloth substrate whether or not it provided milk, the study demonstrated that the provision of milk only in association with the wire surrogate gradually reversed this initial preference. When the cloth substrate did not provide milk, the neonates became progressively attracted to the wire "mother" to satisfy their nutritive needs, indicating that nutritive needs are more important to neonates than are contact needs at that age. This is consistent with the aforementioned findings of Fredericson and colleagues, who found that neonatal puppies are content without direct contact with the mother or littermates as long as they are kept warm. Further evidence that the dog's social response undergoes progressive development is provided by Gantt and colleagues (1966), who were unable to detect a consistent cardiac response to petting in puppies at 2 weeks of age. In fact, they were unable to detect stable cardiac deceleration in puppies under 3 to 4 months of age. The so-called *effect of person* and the calmative qualities associated with petting are not evident in puppies until the close of the socialization period.

Although stable avoidance learning is not consistently obtained before 3 to 4 weeks of age (Fuller et al., 1950), studies have traced the development of such learning during the transitional period. For example, Cornwell and Fuller (1961) found that puppies as young as 15 days of age could learn a reliable (50%) conditioned avoidance response to a puff of air paired with shock. They observed that avoidance learning progressively improves, reaching a 90% reliability by day 19, thus generally confirming earlier studies involving avoidance conditioning in puppies (Fuller et al., 1950; James and Cannon, 1952). Although conditioned avoidance responses can be established, they are developmentally limited to a narrow range of sensory modalities that are functional at the time, making puppies unsuitable candidates for significant early behavior modification or training. With the onset of the socialization period at around 3 weeks of age, dramatic developmental improvements occur in a puppy's ability to learn.

With the close of the transitional period, puppies experience a rapid increase in the amount of social and environmental stimulation that they must process and enter into a long period of adjustment to the environment. Fox (1966c) has compared the general course of puppy development with other altricial species and humans, finding that a similar sequence of developmental events exists for both humans and dogs. The ontogenetic expression of behavior moves steadily from primitive adaptations and reflexive organization to the culminating emergence of

higher behavioral integration. The crucial step in this transition from a reflexive organization to social awareness and identity takes place during the next several weeks collectively known as the critical or sensitive period of socialization.

Socialization: Learning to Relate and Communicate

The developmental period extending roughly from 3 to 12 weeks of age is the most influential 9 weeks of a puppy's life. This period is associated with the development of many social behavior patterns and a great deal of learning about the environment. Much of what is learned during this early period is lasting, providing a foundation for many adult behavior patterns and problems (Fox, 1968), appetites and aversions, social affinities and responsiveness (Scott, 1958), sexual behavior (Fox, 1964b), patterns of active and passive agonistic behavior, play behaviors (Fox, 1966c), packing (allelomimetic) behaviors (Scott, 1968b), reactions to separation and other emotionally provocative situations (Pettijohn et al., 1977), approach-avoidance patterns (Fox, 1966c), the development of dominate-subordinate relationships (Scott and Fuller, 1965), patterns of exploratory behavior and general activity levels (Thompson and Heron, 1954; Wright, 1983), functional fear and avoidance responses (Melzack and Scott, 1957), general learning and problem-solving ability (Fuller, 1967; Lessac and Solomon, 1969), and trainability (Pfaffenberger and Scott, 1959). Virtually every functional behavior system is strongly impacted by the kind of treatment a puppy receives during this period.

Primary Socialization (3 to 5 Weeks)

Prior to week 3, puppies are somewhat socially insulated and only minimally aware of conspecifics. However, with the advent of increased sensory and motor abilities, an extraordinary new interest in social interaction takes place between 3 and 5 weeks of age. A constellation of interrelated behavior patterns and emotional tendencies appear at this time, heralding a lively social awareness and responsiveness (Fig. 2.5). Puppies begin to exhibit more intense signs of distress (e.g., vocalizations and physical efforts to secure contact) when briefly separated from the mother and littermates. Kinship recognition and preference is evident from an early age. Puppies (20 to 24 days) undergoing acute separation distress exhibit a pronounced preference for bedding saturated with the odor of littermates over that of nonlittermates (Mekosh-Rosenbaum et al., 1994). Allelomimetic (group coordinated) activity and social play begin to appear around this time, with the litter behaving like a miniature pack. Playful aggressive and sexual encounters occur frequently between littermates. Various predatory components appear during play, including stalking, pouncing, and shaking. These behaviors are exhibited toward littermates as well as inanimate objects that invite such curiosity and treatment. Additionally, a great deal of sparring takes place between siblings, but the dominant-subordinate roles are unstable, with social status shifting from moment to moment. Puppies spend large amounts of time mouthing and biting each other but appearing to take care not to bite too hard. This period may be a sensitive one for the acquisition of *bite inhibition* or a soft mouth. Some puppies that have been weaned too early in this period tend to bite more vigorously and harder than the norm (Fox and Stelzner, 1967). This inhibitory effect over hard biting may stem from feedback reactions from the mother if a puppy bites too hard while nursing, or from reactions elicited during playful jousting with littermates.

This period is especially important for the development of a stable emotional temperament and affective tone. Many social and emotional deficits observed in adult dogs are believed to result from removing puppies too early from the mother and littermates. Although scientific studies are lacking, ample anecdotal reports and case histories reveal very pronounced effects resulting from early weaning or insufficient socialization with conspecifics. Behavioral sequelae commonly observed as the result of such treatment include emotional rigidness, overreactivity, and

Socialization Period

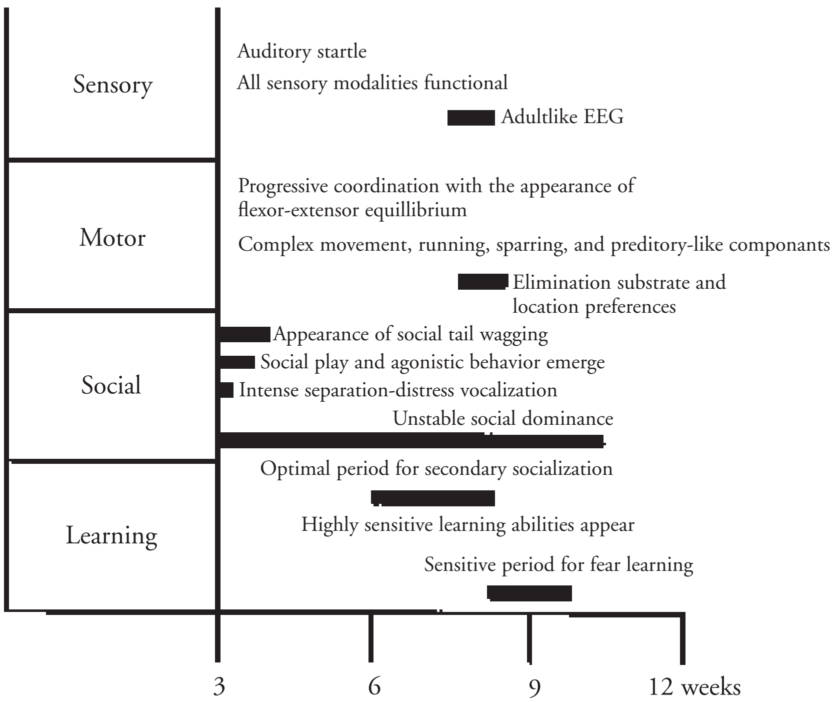

Fig. 2.5. The socialization period includes primary (3 to 5 weeks) and secondary phases (6 to 12 weeks). During this period, active social interaction, bonding, and play emerge as prominent activities occupying the puppy's time.

increased vigilance and anxiety. Such dogs are prone to develop attachment-related problems involving separation distress–evoked behaviors like excessive barking, compulsive destructive behavior, and psychogenic elimination problems. They are more likely to develop aggression problems toward other dogs as adults (Pfaffenberger, 1963). Dogs forming overly exclusive bonds with an owner may become suspicious or aggressive toward strangers, viewing them as a threat to their attachment. When not aggressive, such dogs are often overly fearful of other dogs, preferring human company over that of conspecifics. They are frequently sexually inhibited toward their own kind but may actively redirect such behavior toward their owners. Not all puppies prematurely separated from their littermates exhibit these deficits, but many do exhibit some degree of emotional disequilibrium or deficiency.

During this period, the mother begins to leave the whelping area more frequently and for longer periods. On returning to the nest, she may regurgitate in response to the solicitous behavior of her puppies. The regurgitant feeding response is most commonly exhibited during the final stages of lactation and terminates shortly after weaning (Martins, 1949). Malm (1995) learned from breeder respondents in Sweden that the timing of the first regurgitant response is highly variable, ranging from 3 to 6 weeks of age, with the majority of mothers exhibiting the response for the first time during week 4. Further, the tendency appears to be somewhat breed dependent, with mothers belonging to some breeds being less likely to regurgitate than others. Wilsson (1984/1985), for example, found that, among 17 German shepherd mothers,

none exhibited the behavior during his observations. James (1960) found that regurgitation was often elicited when the puppies attempted to nurse while the mother remained standing. In addition, the puppies exhibited begging behavior consisting of energetic jumping up and profuse licking of the mother's lips and muzzle in an apparent effort to evoke regurgitation. Rheingold (1963) reported only infrequent episodes of regurgitation by the mothers she observed. Such et-epimeletic (care seeking) behavior is probably the behavioral antecedent of adult greeting ritual displays exhibited during homecomings. Fox (1971) has speculated that many adult social behavior patterns may be traced to prototypical antecedents in the dog's early ontogeny (Table 2.2). It is interesting in this regard that besides being solicitous toward the owner and guests, many young dogs and puppies may urinate during excited greetings or when leaned over or reached for, a social pattern that may be ontogenetically related to another alimentary function performed by the mother—lingual elicitation of urination. With the advent of increased motor abilities, puppies wander more widely and begin to leave the nesting area to eliminate on their own. With the emergence of this tendency, the mother stops ingesting the feces. At this time, puppies can be taught to eat semisolid food to supplement the mother's nursing. Eating such rations is socially facilitated by group feeding. The puppies engage in intense exploratory behavior involving sniffing, pawing, digging, chewing, tearing, and picking up a wide variety of available objects. Puppies are enthusiastic and responsive to new social encounters but appear to exercise special preferences for particular individuals they know best. A striking behavioral feature appearing at this time is the development of expressive tail wagging:

> One of the outstanding changes in behavior at the beginning of the period of socialization is the tendency of puppies to respond to the sight or sound of persons or other animals at a distance. The 3-week-old puppy approaches slowly and cautiously toward a human observer seated quietly in its pen. It finally comes close and starts nosing his shoes and clothes. After this, it may start to wag its tail rapidly back and forth. The tail wagging itself appears to have no directly adaptive function, but is simply an expression of pleasurable emotion toward a social object. What effect it has on other dogs is difficult to tell, but it seems to have the same effect on human observers as the

TABLE 2.2. Comparison of puppy behavior antecedents with related adult social behavior patterns

Puppy behavior patterns	Adult behavior patterns
Anogenital presentation during reflex elimination produced by maternal licking	Passive submission displays involving rolling on the side, submissive urination
Licking and leaping directed toward the mother's mouth to elicit regurgitation	Adult greeting routine, active submission—jumping up and licking
Separation-distress vocalizations, yelping, and whining	Adult separation-distress vocalization, howling, and barking
Distress vocalizations	Passive submission vocalizations
Upward head movement, butting—nursing behavior	Social greeting—play solicitation
Competition over optimal nursing sites and food	Dominance-related behavior

Source: After Fox (1971).

> smile of a child; i.e., it is a reward for the person who has initiated a social contact. (Scott and Fuller, 1965:104)

During the neonatal period, the electrical activity of the puppy brain is minimal, with only slight differences being evident between waking and sleeping states. With the onset of the socialization period at 3 weeks of age, a clear and pronounced EEG differentiation can be seen, with an adultlike EEG pattern appearing between weeks 7 and 8. These EEG changes are correlated with significant emotional and physiological concomitants associated with the socialization process. Besides the improvement in brain functions, other physiological changes reflecting emotional responsiveness can be observed. Scott (1958) identified a regular pattern of deceleration, acceleration, and denouement in the heart rates of puppies during the first 16 weeks of life. These changes in heart rate appear to demarcate the onset and offset of the critical or sensitive period for socialization, coinciding with significant changes in approach-avoidance patterns and the intensification of distress vocalization during separation from littermates. Initially, neonatal puppies exhibit a very rapid heart rate. This fast heart rate is maintained throughout the neonatal and transitional periods but then undergoes a sharp decrease after week 3 (parasympathetic dominance) and remains at that level until week 5, when it suddenly accelerates again, peaking between weeks 7 and 8 (sympathetic dominance) before gradually slowing down over the next several weeks toward adult levels. It has been speculated that the sharp dip in heart rate between weeks 3 and 5 results from the integration of corticohypothalamic neural connections and the development of increased sensitivity to emotion-eliciting stimuli and social conditioning. A sympathetic rebound between weeks 5 and 7 is followed by autonomic equilibration and fine tuning over the ensuing several weeks, with a leveling out of heart rate toward adult levels by 16 weeks of age. After week 5, puppies become progressively more cautious and hesitant about making new social contacts—a growing fearful tendency that appears to peak with the close of the socialization period at 12 weeks. Prior to this time, puppies are virtually immune to lasting negative impressions, readily recovering from fearful social experiences without apparent effect or permanent avoidance learning. After week 5, the recovery time following aversive or fear-eliciting stimulation is significantly protracted. This pattern of development culminates in the emergence of adultlike brain activity and the appearance of a particularly sensitive period for fear imprints around 8 to 10 weeks of age (Fox, 1966c).

Scott (1967) has speculated that the development of social attachment and identification results from a combination of two primary developmental pressures. Puppies exhibit an early preference for social contact and familiar locations, becoming distressed when isolated in an unfamiliar place. Such emotional distress is immediately alleviated when contact is reestablished. This pattern of distress and relief ostensibly strengthens a puppy's tendency to maintain close contact with conspecifics and familiar surroundings and, by default, the avoidance of novelty. Intense separation reactions occurring during isolation are well developed by week 3. A simple behavioral analysis may be useful in understanding the motivational dynamics governing the phenomena involved. Contact behavior is intrinsically reinforced by relief from distress associated with isolation, presumably strengthening an underlying social bond with littermates or human companions. Scott (1967) describes an experiment in defense of this hypothesis in which 5- to 7-week-old puppies were isolated from littermates overnight and then allowed contact with human companions for 3 hours during the day. The results of this experiment indicate that the puppies exposed to overnight isolation formed stronger social attachments to human handlers than did controls, suggesting that the aversive emotions generated by isolation are closely related to the attachment process. The emotional reactions elicited by social isolation are intense drive-like affects that overshadow even hunger in priority (separation-reactive dogs are generally anorexic). Separation and isolation represent strong aversive events for puppies and

dogs alike, forming the emotional basis for *time-out* procedures used in puppy training and behavior management.

A fear of strangers appears between 5 and 7 weeks of age and quickly develops over several weeks, culminating in the close of the socialization period during week 12. This developing social fear and reactive avoidance of new social contacts complements the overall solidification of previously established social contacts and bonds.

Secondary Socialization (6 to 12 Weeks)

Unlike most animals, dogs are unusual in that they must adjust to stringent interspecific demands required by domestication. These demands are far reaching, extending from toilet habits to the sharing of affection and play with an alien species—us. A dog must feel equally comfortable in the company of other dogs as well as enjoy human companionship. Such social flexibility is in large measure contingent on early exposure and experience. The process of bonding and social conditioning within the context of the human domestic environment is referred to as *secondary socialization*. For most purposes, secondary socialization begins in earnest when a puppy leaves the mother and littermates to begin life with a human family. The ideal timing for this transition is 7 weeks of age, with a relative range of −1 or +1 (6 to 8 weeks). The 7-week marker is a long-standing convention among insightful breeders and trainers, but it is also supported by various empirical observations (Freedman et al., 1961). Firstly, this period is associated with increasing irritability on the mother's part toward her young, coinciding with the decline of lactation and a growing disinterest in nursing. This disinterest is not shared by her puppies, whose appetites are as sharp as their teeth. Not surprisingly, maternal punishing activity peaks at around this time (Rheingold, 1963; Wilsson, 1984/1985). The mother's job is done both nutritionally and psychologically, making 7 to 8 weeks of age a very sensible time for final weaning and the finding of a new home for her brood. Secondly, within the litter itself, agonistic interaction between the puppies has reached a peak, and although their aggressive play is not intended to hurt, the skills and attitudes developed by such incessant competitiveness does not beneficially serve puppies in terms of their future adaptation to family life.

In addition to the foregoing observations, experimental study of the social development of puppies reveals that several motivational parameters associated with bonding and socialization peak at about this time (Scott and Fuller, 1965). For instance, distress vocalization and reactive behavior exhibited during brief isolation from littermates reaches its highest levels at around 7 weeks of age but undergoes a rapid decline through week 10. Also peaking at this time is a puppy's willingness to approach strangers confidently and to investigate novel things with vigorous tail wagging. However, the strongest support for encouraging adoption during week 7 stems from the progressive potentiation of fearfulness and the simultaneous attenuation of social approach tendencies occurring at this time. This pattern of increasing fear and social avoidance forms a trajectory that culminates with the close of the socialization period sometime after week 12. These two opposing social dimensions (fear and attraction) optimally intersect during week 7 (Fig. 2.6). The balanced interplay of attraction and fear is fundamental to bonding and socialization in the broadest sense.

From what has been discussed, puppies appear to be developmentally prepared to experience the *most* efficient secondary socialization during a short period around 7 weeks of age. However, this does not suggest that puppies younger or older than 7 weeks are unfit or unable to benefit from socialization. The critical or sensitive period hypothesis of socialization stresses that a short period of time, or window of opportunity, exists during which optimal socialization effects can be fully realized. It does not, however, state or imply that socialization occurring outside of these developmental boundaries is not beneficial.

A reasonable objection against delaying secondary socialization until around week 7 might be based on arguments favoring an earlier starting point for socialization. Five-week-old puppies are more outgoing and less

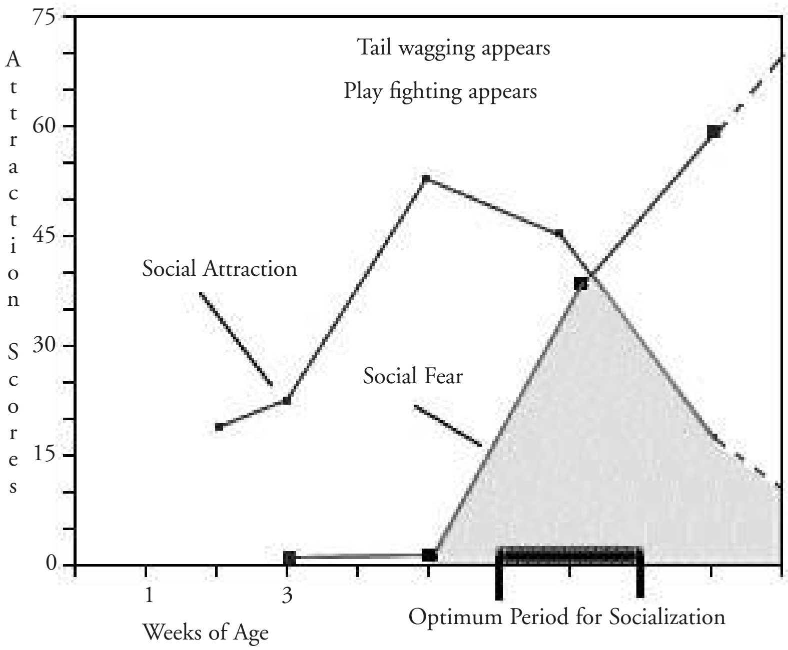

FIG. 2.6. Timing for socialization. Note that the ideal time for initiating secondary socialization corresponds to the intersection of the opposing trends of increased social fear, on the one hand, and decreasing social attraction scores, on the other. After Scott and Fuller (1965).

fearful of social contact than are 7-week-old puppies. It would appear to make sense, therefore, to initiate secondary socialization at an earlier stage in the socialization process rather than waiting. Certainly, it is a period when conscientious breeders should be providing daily and careful handling consistent with a puppy's future placement. However, there are many benefits accruing from keeping the litter intact until week 7. These factors have already been discussed in detail, but to reiterate: puppies removed from the litter too early are at risk of developing adjustment problems of one sort or another as adult dogs. Adoption is a matter of timing. Both the extreme of adopting too early (before week 6) or too late (after week 12, with the emergence of increasing social avoidance) may compete with appropriate socialization or predispose puppies to develop social adjustment problems.

Maternal Influences on Secondary Socialization

A significant factor not yet discussed is the mother's possible role as a model and facilitator of secondary socialization. The primary affectional bonds existing between the individual and the group are elaborated from the primal relationship between the mother and siblings (Harlow, 1958; Scott and Fuller, 1965); however, the mother's influence on a developing puppy in terms of her effect on secondary socialization is not completely understood, and the literature on the topic is divided. Some anecdotal reports suggest that the mother may play an important role in the regulation of aggressive behavior through the exercise of early motherly discipline. The extent of modeling and observational learning on social behavior is not well documented in dogs, but undoubtedly such learning exists to

some extent. The mother's emotional tone and reactivity may encourage similar reactions in puppies via empathy, social facilitation, and observational learning, and thereby "inoculate" them with either a positive or a negative emotional bias toward people and other dogs. Her negative reactions (aggression or fear) may be the result of heredity, her own personal history with people, or a combination of both. In any case, impressionable puppies are at considerable risk of internalizing her attitudes during the socialization period and, perhaps, even before birth (Thompson, 1957). Although observational learning has not been adequately demonstrated in adult dogs (Thorndike, 1911/1965), Adler and Adler (1977) have shown that such learning does exist during puppyhood, at least. The authors emphasize the potential importance of observational learning in the acquisition of social behavior patterns. Slabbert and Rasa (1997) have demonstrated that puppies (9 to 12 weeks of age) exhibited greater trainability as narcotic detectors at 6 months of age if they were permitted to observe their mother performing searching exercises. Kuo (1967) has found that a mother exercises a strong influence on the development of food preferences in her puppies.

This is an area needing more detailed research. It is a common belief that canine progeny reflect more of the mother's emotionality than the father's, but this has not been convincingly demonstrated as a sex-linked outcome. Prenatal and postnatal influences probably exert a more significant influence in these apparent differences. Other behavioral traits are strongly encoded and resist modification by maternal and other social influences. Scott and Fuller (1965) found that many breed-specific behavioral tendencies persist in spite of cross-fostering, isolation rearing, or transferring puppies at various ages to a litter of a different breed. Similarly, McBryde and Murphree (1974) were unable to detect a significant difference between genetically nervous pointer dogs raised with their nervous mother versus those cross-fostered with normal mothers. Finally, Wilsson (1984/1985) has proposed that maternal influences on emotionality may depend more on how the mother treats her puppies during weaning rather than on a modeling effect resulting from her reactions toward humans.

Although much remains to be learned in this area, responsible breeders should "play it safe" and choose only mothers who are exemplary in both form and temperament, not leaning toward excesses in terms of fear, aggression, or excitability. In the case where a litter is born to an unstable mother, puppies should be weaned early (Fox, 1968) and placed under the care of a more balanced foster mother, or the puppies should be hand-fed. As the study by McBryde and Murphree suggests, though, the genetic substrate of such a mating will probably not yield very much to such efforts.

Although the early effects of mother nurturance, modeling, and discipline provide a secure foundation for social development, excessive contact with the mother beyond the first few months may have a disruptive and damaging effect on a dog's development. This is particularly evident in the case of some male puppies kept under the tutelage of an excessively domineering mother for too long. Such puppies may become insecure sycophants, unable to stand on their own and develop their full potential. Another common situation that is rather problematical is when two littermates are raised together. This sort of arrangement is rarely recommended, since very often one of the puppies seems to flourish while the sibling is overshadowed and fails to achieve its potential. Pfaffenberger observed similar difficulties with dogs reared with their mother or sibling:

> At San Rafael, besides the experience of having over-aggressiveness develop in dogs who did not remain under the mother's discipline long enough, we have had some bad effects from overlong canine socialization. I cannot remember a single dog who was raised with her mother to adulthood who could be successfully trained for a Guide Dog. Where two litter

> mates are raised together in the same home we have had the same results. Puppies raised in homes where there are dogs not related to them have never been affected this way by the association with other dogs. ... In the case of two litter mates raised together, one becomes a successful candidate for Guide Dog work and one fails, even if their aptitude tests were equal. (1963:125)

Play and Socialization

Play is an important aspect of dog behavior, exercising a continuous influence over social development and learning throughout the life of a dog. Bekoff (1972) notes that play serves a vital mediational role in the formation of dominance hierarchies among both domestic and wild canids. Threat and appeasement displays are highly prepared, appearing early in a puppy's life and not requiring much learning for their expression. Young puppies exhibit a large repertoire of agonistic threat and appeasement behaviors. These behaviors are often first expressed during playful sparring activities between littermates. Considering the amount of such interaction, it is safe to assume that agonistic play serves an important role in the development of social behavior in dogs. Play depends on a high degree of interactive tolerance, affection, and trust—aspects of play that help to deflect and modulate social antagonisms that arise between closely bonded group members. Playful interaction continues only as long as the players remain friendly and confident. However, play is not simply about the exchange of affection—it is an activity in which various combative skills are practiced and mastered without risk of mutual injury to playful competitors. Agonistic play is a natural way for puppies to evaluate their social standing and to explore limits. Skinner (1982) notes that the aggressive play of puppies is modified and rendered more effective by intrinsic consequences that have no real survival relevance for the puppies besides shaping more effective play. Nonetheless, these early experiences prepare developing dogs for adulthood, making them more effective and skillful when remote contingencies finally do appear that threaten to produce potentially serious consequences. In addition to facilitating agonistic learning, play has many other influential facets that profoundly affect developing puppies, especially with respect to adult social responsiveness and trainability. Eberhard Trumler emphasizes the importance of play in this regard:

> The main point to remember is that the games played during the socialisation period establish once and for all who is a playmate and who is not; if his master takes no part during this period, this is a fact which, from the dog's point of view, governs his attitude in the future. The canine father, who spends much of his time as teacher and trainer, also plays with his puppies; he is adept at using a game to turn his lessons into fun. In this we ourselves can learn from the dog. Development into a good sporting dog or a performing dog which will do all kinds of tricks with genuine pleasure begins in the socialisation phase. Only at this period is the puppy susceptible to learning the joy of learning. Only if account is taken of this natural evolution can a healthy attitude to learning be inculcated and there will then never be difficulties later when something new is demanded. ... Many difficulties will be avoided if one begins, while the dog is still a small puppy, to knit the bonds of confidence and establish one's own position of predominance and command authority by means of a merry game. Then the dog will show not antipathy to the new demands which change his existence but there will be a gradual transition from playing to all those other things which a good dog should be able to do. (1973:125–126)

The role of play in training and social development is more fully discussed in Volume 2, but briefly, in the succinct words of Hediger, "Good training is disciplined play" (1955/1968:139). Play and training are not contrary things, but complementary activities. If puppies or dogs cannot be shown the play in an activity, they will not willingly perform it for long. Nothing is more motivationally important in dog training than play.

Learning to Compete and Cope

With the close of the socialization period, dogs enter into a long period of juvenile development and progressive independence. The remainder of the chapter addresses the

emergence of a number of prominent ontogenetic changes presaging adult social behavior and environmental adjustment. The developments between weeks 12 and 21 are associated with the integration of all major behavioral functional systems, maturing sensory abilities, and learning (Fig. 2.7).

Social Dominance (10 to 16 Weeks)

A dog's tendency to form lasting social bonds is derived from the evolutionary development of the pack as the basic social organization of wolf behavior. In the context of the pack, highly aggressive, possessive, and potentially dangerous individuals are brought together in harmonic coexistence. This close interaction is not without tension and periodic disputes over food, sleeping areas, possessions, breeding privileges, and leadership. These complex dynamics require a sophisticated internal organization and various "rules" governing social exchange. To ensure efficient functioning, pack members are ranked or socially stratified along a continuum of relative dominance. This so-called peck order or dominance hierarchy not only defines status but also assigns the various roles permitted and functions required of an animal's rank in the pack order. Behaving in ways inconsistent with one's status or rank results in social tension and possibly the display of hostilities toward the offending member.

Such organization serves many biologically significant functions. For instance, to be an effective large-prey predator, wolves long ago organized themselves in a way that maximizes their effectiveness as a hunting group. Also, stratified relations of dominance and subordination provide a powerful social glue binding an otherwise aggressive species together into a working unit while simultaneously reducing

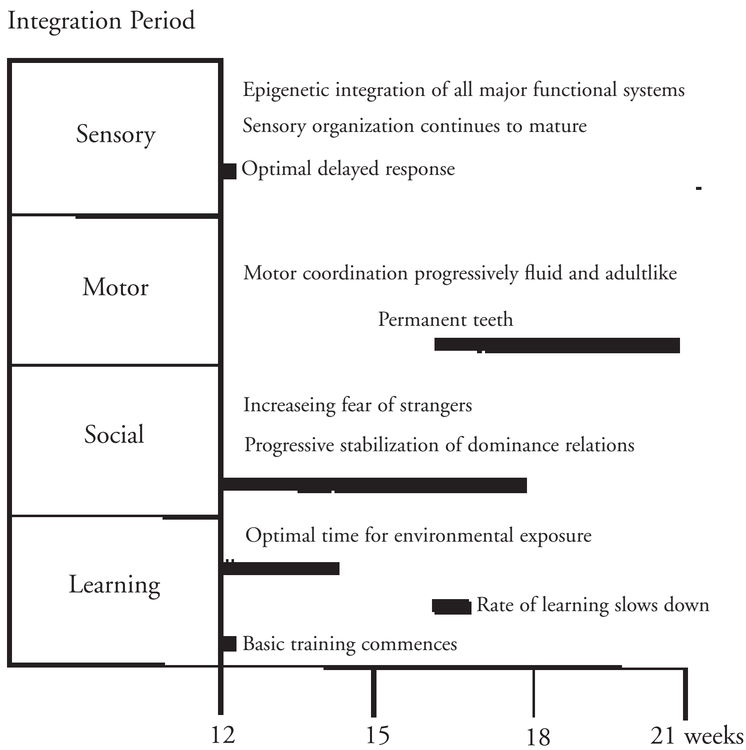

FIG. 2.7. Prominent developmental changes occurring between 12 and 21 weeks of age.

interactive tension and hostilities between members. Within the pack, there is a constant vigilance and tension pressing for the expansion of social power among members. This situation is kept in check through the exchange of ritualized threats and deferential appeasement displays. Serious dominance contests that result in damaging or lethal dominance fights infrequently occur in nature, although such fights occur more frequently among wolves (especially females) kept in captivity. Dominance is structured along sexually dimorphic lines with an alpha male and alpha female at the top of their respective hierarchies. Although the pack is usually led by the male, this is not always the case. Individual members within the pack form "political alliances" among themselves, adding further stability to the pack and complexity to the line of power. One such alliance is between the breeding pair. In essence, the union of the alpha male and alpha female brings the whole pack together in the united purpose of procreation. Social dominance yields two primary benefits to the alpha animal: status and reproductive prerogative. Within the context of the wolf pack, such positioning has tremendous value and is worth struggling to obtain and maintain, perhaps even risking serious injury when necessary.

Social competitiveness among puppies begins early, coinciding with the beginning of the socialization period. James (1955) found that, among 6-week-old puppies, dominant individuals routinely secured food first or threatened or pushed away subordinates. Actual physical attack with biting was rarely observed, indicating that at an early age more ritualized means of resolving competitive disputes are already functional. In a previous study (James, 1949), he found that a more or less stable social hierarchy develops among most litters of puppies by 12 weeks of age. He divides the hierarchy into three main parts: (1) a very *aggressive-dominant* group; (2) a midgroup (a group that may be better termed *subdominant*); and (3) an *inhibited-submissive* group. The midgroup is subordinate to the aggressive-dominant group but exhibits dominance over the inhibited-submissive group. He noted that there was little antagonism among members belonging to the midgroup.

The harmonious interaction of midgroup members may be attributable to the midgroup's ample experience and exercise of both dominant and submissive behavior—that is, they more successfully ritualize their agonistic interaction. In the case of dominant-aggressive puppies, they are unable to defer, generating social tension wherever they happen to be. On the other hand, submissive puppies lack the ability to assert themselves, thus becoming the constant target of more aggressive and dominant littermates. Finally, James (1949) also observed that heated competitive interaction between dominant puppies infrequently resulted in the disputants attacking one another. Instead, a frustrated competitor was more likely to vent his hostility by redirecting it toward a submissive underling remaining at some distance away from the food bowl.

It has been frequently observed that puppies tend to eat more when fed in a social situation than when fed singly (Ross and Ross, 1949). James (1961) found that the effect of social facilitation on eating depends on the relative dominance of the puppies observed. Dominant puppies ate considerably more food in the presence of other puppies than was eaten by more subordinate counterparts. A similar dominance factor may help to explain Scott and McCray's (1967) findings concerning the effects of social facilitation on running speed in noncompetitive versus competitive situations. They determined that paired puppies ran a 200-foot course faster, but only if they were each given a food reward at the end of the run. When a competitive element was added—that is, only the winner was rewarded, the times were slightly depressed. Perhaps, under conditions of competition, the more subordinate puppy may decline to try as hard to obtain the reward. Consequently, the dominant one would not need to run quite as fast to get the food, which would explain the negative effect of competition on running speeds. Incidentally, the depressing effect of competition on running speeds was especially pronounced in

cases where strong elements of competition were evident between the paired puppies.

A large portion of a puppy's interaction with littermates is of a competitive or agonistic nature. Competition may take place over the most productive teats, food, toys, sleeping areas, and, apparently, just for the fun of it. Playful dominance testing and nonspecific social quarreling is commonplace within the litter. The litter in many particulars is very similar to the pack. The latter may only be a more highly organized, purposeful, and regimented development of the former—a progression moving from a nurturing matriarchy to a stable patriarchal stratification of pack members into an organized working group.

Among wolf pups, serious aggressive efforts to establish dominance may appear as early as 30 days of age and result in a stable rank order between contestants (Mech, 1970). In the case of dogs, dominance relations between puppies are rather loosely organized and may change significantly during the early weeks of social development (Wright, 1980). A 7-week-old puppy might go to sleep content with her most recent dominance victory, only to lose it during breakfast the following day. The fluidity and instability of the dominance structure is probably responsible for the constant play fighting and agitation occupying the puppies when not sleeping or otherwise distracted. This social situation becomes progressively more organized through week 11, and by week 15 or 16 it is replaced by a stable social organization of dominant/subordinate relationships (Scott and Fuller, 1965). James (1949) also noted a stabilization of the dominance hierarchy occurring around 16 weeks of age in association with a sharp shift in dominance relations. After this time, the ranking order between the puppies remained stable into adulthood.

Although a puppy's size and sex are important determinants of social status, rank is also affected by various experiential factors, such as the quality and quantity of early social contact. Fisher (1955) found that permissively reared and indulged puppies were usually dominant over other experimental groups, including those puppies that were alternately punished or indulged during social contact, puppies whose social contact was limited to interactive punishment, and puppies that were isolated over the entire period. In comparison with these others, the indulged group was more competitive and aggressive during dominance tests; they consistently controlled the bone in spite of their often being female and smaller. Fisher noted only one exceptional case contrary to this general pattern. Of all the groups of puppies observed, the isolates were the least aggressive and competitive, having apparently lost or suffered a dramatic attenuation of the normal patterns of intraspecific agonistic behavior.

The implications of these findings are important for understanding puppy dominance testing and agonistic challenges directed toward family members. Prior to week 11, dominance positioning is more or less sham and labile, but as puppies move into month 4 and beyond, they become progressively more confident and defensive about their dominance status. Such puppies can be extremely "testy" and are often prepared for a battle of wills. As the result of previous playful fighting, dominant puppies may engage in persistent and provocative mouthing on the hands and clothing of their innocent and confused human companions, who may be of the false opinion that their puppy's oral excesses are mainly due to teething, exuberance, or affection. Precocious dominance aggression is occasionally observed among puppies of this age group. The problem with early displays of excessive mouthing or dominant behavior is that it frequently prefigures adult dominance-related problems. Further, since a dog's behavior is most flexible and malleable before 16 weeks of age, it is important that such issues be resolved by then. Many *gentle training* and massage techniques are now available to help facilitate subordination and cooperative behavior in puppies.

While young puppies may also engage in such testy behavior, their willingness to abandon the urge to dominance test and mouth makes it easier to modify or redirect. A general rule of thumb when choosing a puppy is to pick one that fits somewhere in the middle of the litter dominance hierarchy. Determin-

ing where a puppy lies within the peck order is not always easy, since dominance relations are loosely defined, especially during the early weeks. Tests devised by breeders and trainers to scan for and rate relative dominance have come under recent suspicion (Beaudet et al., 1994) although, as matters stand, testing can be useful even if the results are not entirely reliable as *fine* predictors of future behavior. There can be no doubt, however, in cases of extremes (as in overly aggressive or fearful temperament types) that such tendencies can be isolated by temperament testing performed by an experienced evaluator. Puppy testing has been used for predicting trainability in military working dogs (U.S. Army's Biosensor Research Team) and selecting guide-dog candidates (Pfaffenberger, 1963). Recently, however, Wilsson (1997) has questioned the validity of early puppy tests for predicting suitability for service-dog work. His tests carried out with 8-week-old puppies failed to detect predictive indicators for trainability when the dogs were tested again at between 15 and 20 months of age. Despite these problems, a good biweekly or weekly testing regimen may be beneficial for puppies simply because of the added attention and learning experiences it provides—contact that might not otherwise be available. These instruments are not intended to assess or predict potential temperament flaws or future performance in any particular area but are employed to evaluate a puppy's temperament at the time of testing and to define areas that may need special attention. Subsequent testing can be used to monitor a puppy's progress objectively.

Social Attachment and Separation

Puppies form very strong social attachments and become emotionally reactive and distressed when separated from littermates or the mother. For immature dogs, maintaining social contact enhances their chances of survival and is probably a strongly prepared canid trait. Sustained distress vocalization may serve to attract the attention and aid of the mother. Under conditions where help is not forthcoming, puppies (and the separation-anxious adult dogs) appear to become fixated in an unresolved state of emotional tension and progressive reactivity. The consequence of unanswered distress vocalization is escalation and perseveration. Several factors influence the magnitude of distress vocalization. Fredericson (1952) found that puppies separated from their littermates vocalized much more when confined alone, averaging 211 vocalizations per 5 minutes of observation versus 30 vocalizations when confined with a companion puppy. Another important factor is the location of confinement. Elliot and Scott (1961) found that puppies confined in a familiar area are much less reactive to separation than matched counterparts confined to a strange pen (Fig. 2.8). Furthermore, puppies tested in a familiar area appear to adjust progressively to separation from week 3 onward, whereas counterparts exposed to confinement in a strange area exhibit rising levels of distress that culminate during week 7. Comparing the two groups at 7 weeks of age shows that puppies confined to a strange pen are more than three times as reactive than those puppies confined in a familiar pen.

Pettijohn and colleagues (1977) carried out a series of experiments to compare various means of alleviating separation distress in young puppies. They compared the occurrence of distress vocalization in the presence of various stimulus conditions: food (bones, familiar food, and unfamiliar food), toys (hard toy, soft toy, and towel), dog contact (mother, unfamiliar dog, and mirror), and human contact (observer behind wire, passive handler, and active handler). The least effective stimulus condition for the attenuation of separation distress was food, with unfamiliar food being slightly more effective than familiar food or bones. Among toys, the strongest alleviation was obtained with soft objects, including a stuffed animal and a towel. The provision of hard rubber toys yielded no benefit. Interestingly, the withdrawal of the soft toys resulted in a distress surge moving above pretest baseline levels. The mirror produced a strong modulatory effect on distress vocaliza-

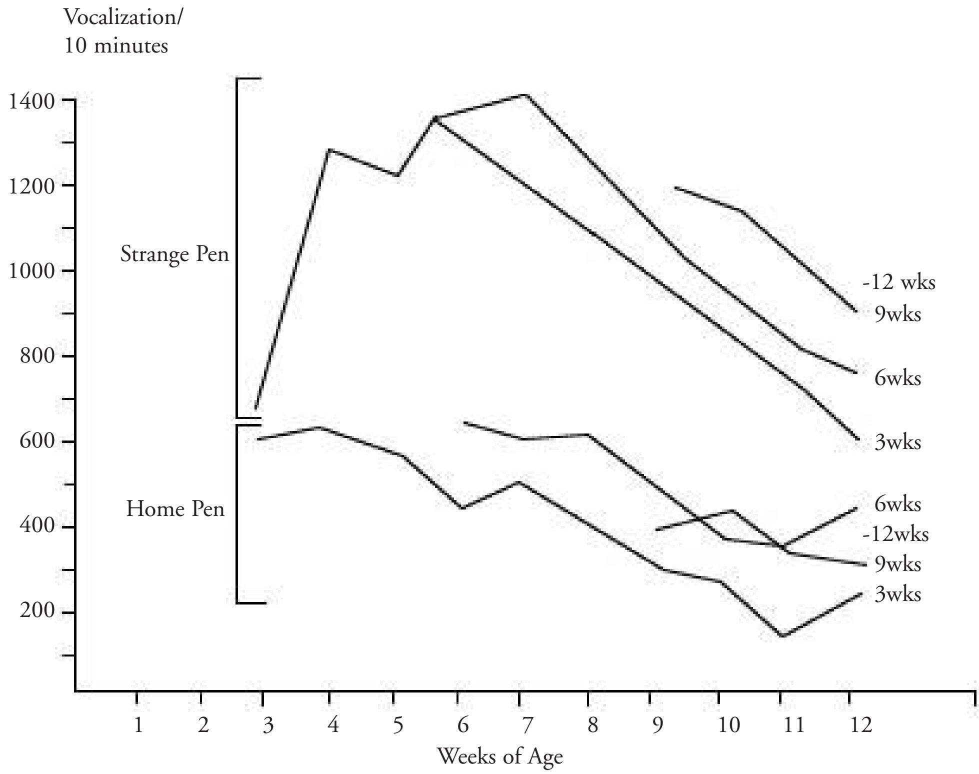

FIG. 2.8. Distress vocalization is affected by context, with the familiar home pen producing significantly less distress than that occurring in the strange one. Note that separation-distress reactions in the strange pen peak between 6 to 8 weeks. After Elliot and Scott (1961), with permission.

tion, only slightly less so than the presence of the puppy's mother. They observed little difference in the effect of the mother versus an unfamiliar dog. The most effective attenuation of separation distress (even better than contact with the mother) was produced by both active (slightly better) and passive contact with a human handler (Fig. 2.9).

The manner in which separation reactivity and distress is handled may dramatically effect how well a puppy copes with being left alone. Care should be taken to expose the puppy gradually to increasing confinement and graduated separation experiences. Traumatic crate training, excessive confinement, long-term isolation, and dependency-producing affection rituals (excessive pampering and coddling) may contribute to the later development of separation problems. Young puppies have a strong developmental need for close, sustained social contact with conspecifics—a need that a new owner must satisfy. The practice of having a puppy sleep in the kitchen or laundry room (often allowing the puppy to cry to point of exhaustion) is not a sensible approach, since such experiences may sensitize the puppy to react negatively when confined or when left alone. Early confinement experiences associated with high degrees of distress may potentiate unwanted separation reactions, including destructiveness, excessive vocalization, or house soiling. By exposing puppies to gradual increments of confinement and separation, they can more naturally habituate and learn to accept being left alone when that is necessary.

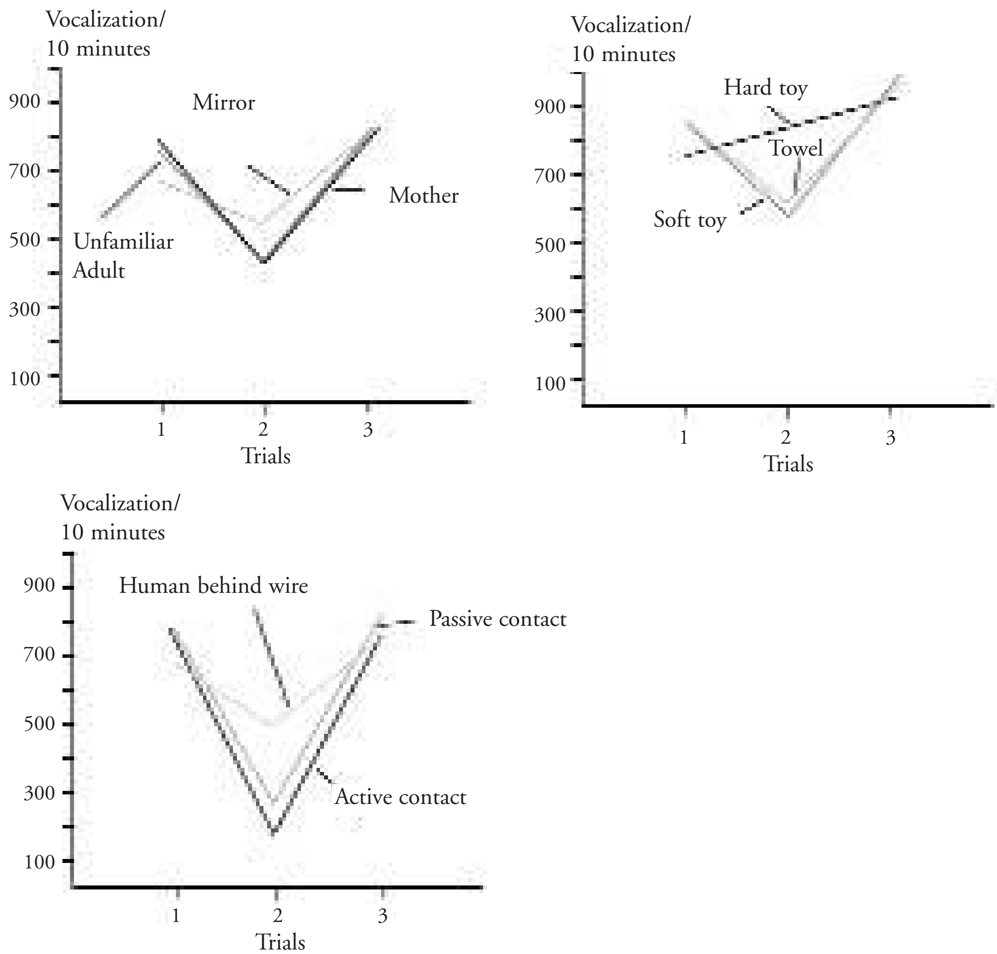

FIG. 2.9. Shows vocalization before (trial 1), during presentation (trial 2), and after withdrawal of the test stimulus (trial 3). Note that contact with a passive or active human produces more reduction of separation distress than when in the presence of the mother. After Pettijohn et al. (1977).

Puppies not exposed to separation experiences early in their development tend to become excessively reactive when they are finally exposed to it. Elliot and Scott (1961) evaluated the reactions of several groups of puppies that were exposed for the first time to separation in a strange pen at different ages beginning at week 3. The puppies were divided into four groups. Group 1 was first exposed to separation in a strange pen at 3 weeks of age—an experience that was subsequently repeated on a weekly basis through week 12. The other puppies were similarly exposed to weekly testing, but it was delayed until they were 6 weeks old (group 2), 9 weeks old (group 3), and 12 weeks old (group 4). Interestingly, puppies belonging to group 4 that were not exposed to separation until 12 weeks of age appeared to panic and were unable to cope effectively with such experiences, whereas the other groups (especially group 1) appeared to have learned how to adjust more effectively when separated from littermates—that is, they appeared to have habituated to the separation experience (Fig. 2.10). Additionally, this study also demonstrated that there exists a definite relationship between increasing reactivity to sep-

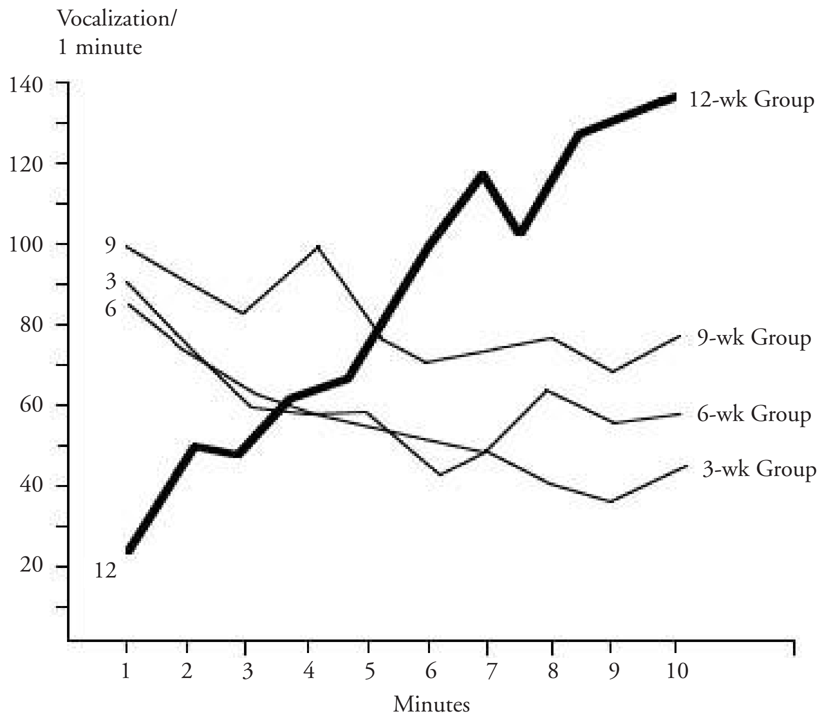

FIG. 2.10. Pattern of habituation to separation at various age groups. Note strong reaction of the 12-week group not previously exposed to separation. After Elliot and Scott (1961).

aration and the appearance of the hypothetical optimal period for secondary socialization at around 7 weeks of age. The separation reactivity of the 3- and 6-week-old puppies clearly peaked at this time (Fig. 2.8).

There appears to be no direct link between the emotions of fear (e.g., startle) with separation anxiety (Davis et al., 1977). Also, Scott (1967) concludes, on the basis of studies involving chlorpromazine, that the tranquilizer's effect on separation distress is the result of generalized sedation rather than a reduction of anxiety:

> In moderate doses the tranquilizer chlorpromazine has the effect of slowing down the rate of vocalization, but larger doses do not produce a proportionate increase in the effect, which appears to be an indirect result of sedation rather than a direct effect of alleviating the emotion. Under this drug a puppy with his litter mates will be sound asleep. Placed in a strange situation, he immediately gets on his feet and starts vocalizing, at a somewhat lower rate than usual, but without a letup. Assuming that chlorpromazine has the effect of alleviating anxiety, and defining anxiety as the emotion generated by anticipation of events in the future, we can conclude that anxiety plays little part in the emotional responses to isolation in a strange place. (1967:124)

Although both fear and anxiety appear to be distinct from separation-distress reactions, punishment tends to paradoxically increase attachment behavior in young puppies (Fisher, 1955; Stanley and Elliot, 1962). Therefore, punishing a separation-anxious puppy may *indirectly* make the animal's separation distress worse, resulting in increased barking, yelping, and the exhibition of other separation-related behaviors. A similar effect has also been reported by Hess (1964), who demonstrated that attachment behavior among chicks is facilitated by the delivery of mild electric shocks presented during the imprinting process. Additionally, confining a puppy to a crate may make things worse. De-

spite a widespread belief to the contrary, a puppy does not appear to feel more secure when restrained in a crate. Ross and colleagues (1960) found that puppies were especially reactive to separation when restrained—whether alone or with a littermate. Restrained puppies were three times more reactive than unrestrained littermates exposed to the same conditions of isolation (Fig. 2.11). The degree of familiarity with the location of restraint also appears to play an important role. Puppies are much less separation reactive when confined in a familiar area. When puppies are restrained in an unfamiliar area, however, emotional reactivity is greatly amplified, with the frequency of distress vocalizations doubling in number (Scott, 1967). These laboratory findings suggest that the practice of confining a puppy in a remote part of the house (like the basement) should be avoided.

Although some risk exists in punishing a noisy puppy, it may be necessary to do so [e.g., a loud clap of the hands and reprimand or the toss of a shaker can (a soda can with several pennies in it)] for the sake of expediency, especially where sustained desensitization efforts have failed or have produced only modest results. Whenever possible, however, distress vocalization should be managed by shaping quiet behavior with rewards and performing a series of graduated departures. Even in cases where punishment is successful, the suppressed distress vocalization may only end up being replaced with a worse problem like house soiling or destructive behavior (Borchelt, 1984).

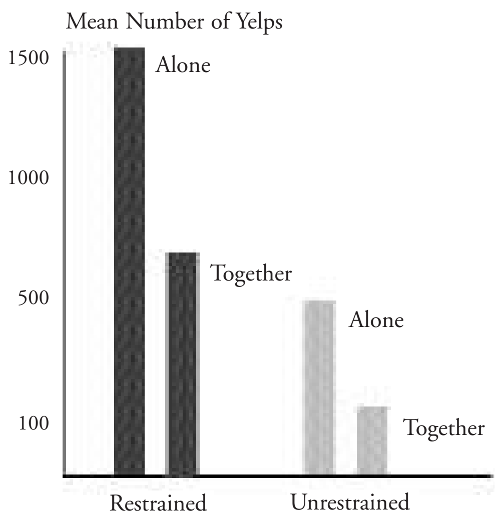

FIG. 2.11. Restraint has a pronounced potentiating effect on distress vocalization in puppies separated from littermates in a strange place. After Ross et al. (1960).

LEARNING TO ADJUST AND CONTROL

The foregoing discussion has emphasized the role of early socialization and attachment in the ontogeny of puppies. Puppies that fail to receive sufficient contact during the critical period of socialization may exhibit lasting deficits in their social responsiveness and general trainability. To gain the most benefit from the least effort and investment of time, it has been demonstrated that timing is of vital importance. In fact, it has been estimated that as little as *20 minutes of social contact per week* during the socialization period is sufficient to offset the adverse effects of social isolation in puppies (Fuller, 1967). With such an impact occurring as the result of minimum social contact, one can only imagine the potential benefits possible for young puppies that receive that amount of focused attention every day.

Environmental Adaptation (3 to 16 Weeks)

Of equal importance to a puppy's psychosocial development is access to a varied environment rich in diversity of objects, textures, and structures with which to interact and explore. A puppy's curiosity and excitement about the external environment emerge along with the development of the various senses and motor abilities. Nature itself provides a boundless outlet for a puppy's inquisitiveness and exploratory activity. For instance, an outdoor excursion or a playful romp in the woods provides a profusely enriched environmental experience. Nature is the most readily available resource for sensory-motor exposure and locomotor experience and experimentation, but exposure to nature alone is not enough to ensure adequate stimulation and

adjustment. Although the natural environment provides puppies with outlets for exploratory behavior, they must also be exposed and habituated to stimuli associated with the artificial environment within which they will spend the majority of life. This includes exposure to the sounds of traffic, everyday noises like a vacuum cleaner, and various other noisy appliances and routines.

A puppy's sensory and psychological need for environmental exposure is supported by the results of many studies on the effects of isolation on development. Thompson and Heron (1954) compared the effects of severe, moderate, and normal restriction on general activity and exploratory behavior. Their results show that activity levels and exploratory behavior significantly increased, depending on degree of restriction, but these differences gradually narrowed as a function of remedial exposure and maturity, suggesting that some of the effects of early restriction are reversible. Thompson and colleagues (1956) observed that, in addition to increasing general activity levels, severe restriction resulted in the development of compulsive whirling and tail snapping in isolates. Of 11 Scottish terriers exposed to severe restriction, eight developed the stereotypic habit of whirling. Fisher (1955) also observed similar whirling behavior exhibited by isolates while in their home cages; however, after several weeks of exposure to a nonrestricted and socially enriched environment, the whirling habit disappeared. The habit was most conspicuous among wirehaired terriers. Fox (1967) found that even short periods of partial isolation early in the socialization period produced pronounced effects on behavioral and neurological functioning. Isolates were restricted to a darkened room for 1 week (week 4) with human contact being limited to 1.5 minutes per day for cleaning and feeding. Controls were kept in a similar cage but with greater exposure and contact with other dogs. The gross behavior of isolates was different from controls along several dimensions: isolates were much more active, their behavior was disorganized, and they tended to ignore visually and tactilely interesting objects (a mirror, toy, and piece of cloth). Although both isolates and controls were attracted to a cloth item, the isolates spent most of their time sniffing rather than biting or playing with it. When the mirror, toys, and cloth were removed, isolates were unaffected whereas controls scratched at the door or searched the testing area while whining or crying. Controls approached the mirror with tail wagging whereas the isolates took no interest in it. In general, isolates were socially withdrawn (exhibiting little vocalization or tail wagging) and did not engage in playful interaction with littermates. Further, isolates showed a preference for inanimate objects and engaged in self-play instead of making social contact with other puppies or observers. Fox also found that exposure to short-term isolation resulted in the display of tail chasing and whirling previously observed by Thompson and colleagues.

In addition to the behavioral deficits resulting from short-term partial isolation, Fox (1967) found several correlative alterations in brain-wave activity of the isolates when compared with controls. From these observations, he concluded that isolates were overwhelmed by intense arousal stimulated by the enriched testing area. He speculated that isolates suffered an increased sensitivity to sensory stimulation. The neurological locus of the dysfunction may have been "acute reticular arousal," rendering the isolate unable to filter out irrelevant from relevant input. The outcome of overarousal was a short-circuiting of the isolate's ability to select appropriate and adaptive responses to the impinging stimulation affecting them. Under the influence of remedial exposure, short-term isolates quickly recovered and appeared normal according to behavioral and EEG parameters after 7 days.

The effects of long-term isolation have also been studied. Lessac and Solomon (1969) isolated puppies from 12 weeks to 12 months of age and then compared their behavior under various testing situations with that of controls raised under the influence of social contact and environmental exposure. Isolates exhibited many "psychologically destructive, deteriorative, or debilitative effects" (1969:22). During observations of free-ranging behavior, the experimenters found that isolates exhibited sustained generalized arousal, high motor activity, diffuse emotion-

ality, and distractibility, perhaps representing a developmental model of hyperactive-attention deficit disorder. The isolates frequently bumped into furniture and walls. They appeared oblivious to their surroundings, swept up in a vortex of "diffuse and disorganized behavior." They ignored external sounds and barked at irregular intervals independently of what they happened to be doing or attending to at the moment. While many of them raced toward the experimenter when he entered the room, they failed to make any contact. They simply raced by as though not seeing him.

In contrast, the controls, which were raised with social contact and environmental exposure, were much more focused and directed in their free-ranging activities. When they barked, the barking was directed at someone or something. They also spent a lot of time pawing at the door separating them from the experimenter. Although initially very excited, the puppies calmed down within 5 minutes. They intently sniffed and explored the test area, frequently spending as long as 90 seconds exploring a single object attracting their attention. When noises occurred on the outside of the room, they quickly oriented in the direction of the sounds. When the experimenter entered, they all approached and followed him around the room.

Two particular test situations revealed striking signs of disability involving coping mechanisms and the breakdown of previously learned behavior, especially with regard to effects associated with frustration and pain/fear reactions. Lessac and Solomon tested 12-week-old puppies on their ability to solve a simple barrier test and to learn a shock-escape/avoidance response. The experimental isolates and controls were subsequently tested at 12 months. The barrier test requires that a puppy go around a wire barrier in order to obtain meat on the other side. Puppies at 12 weeks of age exposed to this problem solved it within 50 seconds (all values are mean approximations). Testing after a year revealed that isolates languished behind the barrier for up to 130 seconds before solving the problem, while the socialized/exposed controls solved the problem within 10 to 15 seconds—substantially bettering their scores observed at 12 weeks of age. Interestingly, Fox (1967) found that week-4 isolates were significantly slower than controls in solving this barrier test, as well. The author noted that, instead of eating as the controls did, the isolates nibbled on the meat briefly and ran off. Instead of improving over a number of trials, the isolates' ability to solve the problem appeared to deteriorate with practice.

The study also tested the isolates' ability to learn a simple shuttle-box escape-avoidance response. The puppies were placed in a box divided into two compartments divided by a shoulder-high barrier. The discriminative stimulus signaling pending shock was a 10-second darkness interval. The moment the puppy jumped the barrier, the light was turned back on and shock terminated. Shock was continued for up to 1-minute duration or until the puppy jumped over the barrier. The mean time for 12-week-old puppies to escape shock was 16 seconds. Interestingly, one of the experimental groups that had not received training at 12 weeks prior to being isolated did particularly poorly on this test, taking 45 seconds to jump the barrier while receiving continuous shock. This is in sharp contrast to the socialized control group (which also had not received training at 12 weeks), which successfully jumped the barrier in 9 seconds. In both of these tests, a strong emotional component involving frustration and pain/fear is involved. Isolates appear to possess particularly poor adjustment skills when it comes to situations charged with frustrative or fearful components.

Fuller (1967) also reported a series of experiments examining the effects of isolation on puppy behavior and has evaluated various techniques for reversing its effects (Fuller and Clark, 1966a, 1966b). Fuller exposed several groups of puppies to varying amounts of isolation to determine the causes underlying the isolation effect. Consistent with findings of Lessac and Solomon (1969), Fuller observed that isolates tended to exhibit striking emotional, sensory, and motor deficits when first exposed to an open area for observation.

However, Fuller has interpreted these findings in a somewhat different way. Lessac and Solomon viewed isolation as having a destructive, deteriorative effect on the isolate, whereas Fuller explains the isolation effect in terms of an emergence-stress response. Unlike controls that have had a chance to habituate to the complex stimuli associated with ordinary levels of stimulation, isolates when first exposed to an ordinary environment are overwhelmed by its novelty and complexity. Since they are inadequately prepared to process and respond to the stimulation, they are seized by various emotional reactions and bizarre behaviors that block more appropriate and adaptive coping behaviors. Even when puppies were raised together in pairs or permitted access to toys in their cages, the isolation effect was still evident when they were finally released from confinement.

Fuller has theorized that the behavior of isolates is precipitated by an emotional state incompatible with normal adjustment. Consequently, he carried out a series of experiments based on this simple hypothesis: if postisolation disturbances of behavior are due to excessive emotional arousal, then such disturbances could be ameliorated if the emotional reactivity of the isolated puppies was reduced. To test this hypothesis, he exposed isolates to two emotion-reducing influences: handling and chlorpromazine. Fuller found that isolates handled or given a combination of handling and chlorpromazine prior to exposure performed more like normal controls (Fuller and Clark, 1966b). Fuller and Clark conclude that isolated puppies (provided that they are not genetically hypersensitive to the effects of isolation) can recover their emotional and sensory equilibrium if exposed to appropriate handling and/or drug therapy:

> It appears that much perceptual organization can take place with minimal stimulation, and that appropriate responses can be elicited readily in post-isolates if interfering behavior is controlled. Certainly the intensity of post-isolation effects can be greatly modified by varying the conditions of emergence. Under especially favorable circumstances, forced contact with the handler, a suitable dose of chlorpromazine, and a robust genotype, the post-isolation syndrome can be totally eliminated. The outlook for the experientially deprived organism may be more hopeful than recent experiments have indicated. (1966b:257)

Development of Exploratory Behavior

Socialization and environmental exposure practices should follow an age-appropriate pattern. Waiting until a puppy is 16 weeks old before letting it venture out into the real world is too late. On the other hand, exposing a puppy too early to too much stimulation may generate negative side effects, as well. Scott and Fuller (1965) found that puppies reared under semiferal conditions avoided excursions beyond 10 to 20 feet from their home boxes until they were around 12 weeks of age. Such information suggests that a puppy's readiness for environmental exploration and exposure is developmentally sensitive. Some puppies do, in fact, strongly object to leaving their immediate home environments until after they reach 12 weeks of age, yet many puppies as young as 7 weeks old happily explore new environments as long as they are in the company and safety of a human guardian.

Fox and Spencer (1969) carried out a series of experiments to determine the relative importance of experience versus age on the development of exploratory behavior. The puppies they studied were divided into two groups depending on the sort of test exposure they experienced at different ages. Cross-sectional exposure involved exposing puppies to the novel stimulus situation at various ages, some at 5, some at 8, some at 12, and some at 16 weeks of age. The second group, longitudinal exposure, had puppies exposed to novel stimulus situations at each of the above test periods. In other words, the cross-sectional group was exposed to only one test period overall, while the longitudinal group was exposed to all four test periods. The worst deficits were observed in the cross-sectional groups exposed to the test situation at only weeks 12 and 16, suggesting that early experience with novelty is crucial for the development of normal exploratory behavior. The

study revealed that the longitudinal group became progressively more exploratory than the cross-sectional group over time. The puppies receiving longitudinal exposure via testing to novel stimulus situations significantly benefited in terms of their tendency to explore and tolerate novel situations and events.

Wright (1983) has studied the effects of different rearing practices on exploratory behavior and stimulus reactivity in German shepherd puppies. He tested and evaluated the differential effects of hand rearing versus litter rearing on the exploratory behavior and stimulus reactivity of puppies at 5.5 weeks and 8.5 weeks. His findings indicate that hand-reared puppies are significantly more curious, spending more time in close proximity to and examining more frequently novel objects placed in their environments. In contrast, litter-reared puppies are much more reserved and avoidant toward novelty at 8.5 weeks of age than are hand-reared counterparts. Wright concludes that rearing practices should include active handling and environmental exposure early in a puppy's life to both enhance curiosity and receptivity to novelty and to prevent the development of fearful avoidance responding:

> There are practical applications of these findings for breeders interested in increasing the chances that their pups will not develop avoidance reactions to unfamiliar aspects of their environment. First, rearing pups together, with access to large areas for locomotor activity, may not be an adequate rearing-procedure by itself. Second, handling, and the exposure to unfamiliar people, other animals and other novel stimuli (characteristic of hand-rearing) may be a more effective rearing-strategy. (1983:33)

During outdoor excursions, extra precautions should be taken to minimize risks on at least two fronts: (1) the risk of exposure to communicable disease and (2) the risk of exposure to traumatic or overly threatening experiences. The first danger can be mitigated by avoiding places frequented by other dogs and keeping the puppy's vaccinations up to date. The second caution is harder to guard safely against. As previously mentioned, there is a particularly sensitive period for the development of lasting fear impressions, extending roughly between weeks 8 and 10. For instance, if a puppy is accidentally stepped upon as a 9-week-old, he may develop a chronic fear of feet or shoes. Many adult phobic reactions in dogs may have their origins stemming from experiences occurring during this period.

Careful environmental exposure carried out systematically through gradual increments of intensity and duration allows puppies to habituate to potentially fear-eliciting stimuli without undue distress. A puppy's environment should be rich in diversity of objects, textures, and structures with which to interact and explore. A puppy's curiosity and excitement about the environment emerges as the puppy matures and develops greater confidence in the complementary directions of emotional security and physical dexterity. Owners should refrain from reassuring nervous puppies by petting and soothing words while the puppies exhibit fear, even though it seems so natural and appropriate. The provision of such emotional support is hard to resist, but it may inadvertently strengthen a puppy's fearful reaction rather than reduce it. Attempts to relax and calm puppies should be made prior to exposing them to the fear-eliciting stimulus.

An effort should be made to expose puppies to a wide variety of physical and social situations, while being careful to ensure that they are positive experiences. Techniques for reducing fear responses are discussed in great detail later, but the key to environmental exposure is a patient, gradual, and orderly progression of direct interactive exposure. It is useful to engage puppies in an activity that they have already learned and enjoy while such exposure is taking place—for example, walking quietly on the leash, playing ball or fetching a stick, taking treats of food, or receiving petting and praise. Keep the process active and moving, ever-prepared to distract puppies should they become too fearful or alarmed. In general, puppies engaged in some activity or movement tend to be less anxious and fearful than those unoccupied or standing still.

The staging of environmental adaptation experiences should include exposure to those things that are desirable for puppies to ap-

proach as well as teaching them the things and activities to avoid. Just as fears and phobias are readily established during the socialization period, appetites and potentially harmful activities are also quickly learned. Many problems can be avoided by carefully selecting chew toys that cannot be easily generalized to valued personal belongings. Giving a puppy an old shoe, socks, discarded plastic bottles, a broken chair leg, or carpet remnants establishes such objects (and similar ones) as chew toys. The consequence is to inadvertently turn the entire house into a sumptuous temptation for an orally active and exploratory puppy. In addition to the very likely possibility that oral preferences are imprinted to some extent, chewing for the dogs is both physically and psychologically satisfying. Consequently, puppies may develop a lifelong appetite and preference for items presented to them for oral entertainment early on. These acquired preferences may persist indefinitely or until they undergo aversive counterconditioning or punishment, a rather unfair outcome since the whole situation could have been prevented by more careful selection of chew toys in the first place. Prevention rests on directing oral exploration into outlets of greatest satisfaction and limiting these outlets to a small number of objects easily discriminated from personal belongings. Efforts to prevent puppies from engaging in inappropriate or destructive chewing behavior should include careful supervision and confinement. Unfortunately, crate confinement often takes the place of puppy training. Although the crate performs a useful function in puppy training, it is often used in excess or as a permanent method of daily confinement. Long-term or excessive reliance on crate or kennel confinement may have an adverse effect on the social behavior of an otherwise well-socialized puppy (Fox, 1974).

Learning and Trainability

The socialization period extends roughly from weeks 3 to 12. Throughout this period, puppies exhibit a pronounced sensitivity for the acquisition of a wide variety of social and environmental coping and adjustment skills. If puppies are not provided with adequate social contact or exposure to an environment rich in variety during this period, their psychosocial development may be significantly compromised or impaired. Such puppies are unlikely to reach their full potential as adults and may be at risk for developing a variety of behavior problems linked with developmental deficits or trauma occurring during these early formative weeks. Controlled studies show that puppies are able learners; in fact, this period could very aptly be called the "critical period for social learning." At no other time in a dog's life is he more receptive to training based on affection and reward. EEG measures and the results of many behavioral studies demonstrate that 8-week-old puppies function at nearly an adult level in terms of learning ability. Apparently, however, as puppies mature, the ease with which they learn noticeably begins to decline by about 16 weeks of age (Scott and Fuller, 1965):

> As to basic learning capacities the puppy appears to be fully developed before the outset of the juvenile period. At about 4 months of age the speed of formation of conditioned reflexes begins to slow down. This is probably not because the nervous system deteriorates but rather because what the puppy has previously learned begins to interfere with new learning. As will be seen later there is some evidence that the behavior of the puppy begins to reach a stable organization about this age; that is, he has established the foundation for what he will learn in the future. (1965:109)

Fox performed a number of experiments to explore the developmental constraints affecting early learning in dogs. For example, in one of these influential studies, he trained puppies at various ages to run toward a handler positioned at the end of a short runway (Fox, 1966b). The puppies were divided into three age groups, ranging from 5 to 13 weeks of age. After the above preliminary training was carried out, the puppies were exposed to a mild shock that was delivered just before they reached the handler. The results from week to week were somewhat surprising and puzzling. Fox found that the 5- to 6-week-old puppies tended to "forgive" the handler

between the weekly testing sessions and would approach without hesitation despite past shock experiences. On the other hand, puppies belonging to the 8- to 9-week-old group tended to be much more avoidant, with half of them refusing to approach at all. In contrast, the 12- to 13-week-old puppies tended to persevere and continued to approach the handler, apparently ignoring the threat of shock. From these results, he concluded that avoidance training prior to week 8 is not practical since the effects of such learning tend to degrade rapidly. However, waiting until the puppy is 12 or 13 weeks of age may be too late for the initiation of some forms of avoidance training. The best time to commence mild avoidance training appears to be around 8 to 9 weeks of age:

> Conditioned avoidance (electroshock on approach to human) was unstable in pups aged between 5–6 weeks, so that learning at this age cannot be reliably undertaken, for without considerable reinforcement, the learned response will disappear with age. In some pups aged 8–9 weeks, electroshock caused stable conditioned avoidance indicating this age is a sensitive period when certain traumatic stimuli have the most marked effect. Thus inhibitory training (sit, stay and house breaking) may be most easily accomplished at this time. By 12–13 weeks of age, inhibitory training is more difficult to establish for emotional attachment to man may interfere with certain inhibitory training procedures. However, leash training to heel, follow and retrieve on the basis of these findings could be commenced at this age. Thus reward training (food, or contact by stroking and vocal reward) by virtue of the close emotional bond that can be established between dog and trainer, can best be commenced at 3 months of age. (Fox, 1966b:285–286)

In another experiment, Fox and Spencer (1967) studied the development of delayed-response learning in dogs. Positive results from delayed-response testing have been strongly correlated with higher cognitive functions and working memory. To navigate the delayed-response test successfully, puppies must be able mentally to represent significant features of the stimulus situation, hold that information in memory across time, and apply it to the problem at hand. The basic experimental situation utilized by the experimenters consisted of an 8-foot (2.4-m) by 8-foot testing area containing a starting box and three other boxes uniformly distributed in the space. One compartment, the neutral box, located in the rear center of the area, never contained food. The experiment required that the various groups of puppies learn to identify the location of a piece of hidden food by relying on secondary cues provided by the handler's position. In other words, the puppies had to first learn that the hidden food could always be found in the compartment located closest to the handler. Gradually, they were exposed to increasingly difficult requirements and then tested for delayed-response abilities. The test phase of the experiment involved allowing puppies to observe the location of the handler and then blocking their view of the situation by briefly closing the starting box, at which time the handler left the testing area. Once clear, each puppy was released into the area but without the advantage of the handler's presence to help it locate the hidden food—the puppy had to remember the handler's location in order to solve the problem. The delay was gradually increased over several trials, and the puppies' performance recorded at various ages. The experiment revealed that puppies differed in their delayed-response abilities according to their age.

Interestingly, both the 4-week-old group and the 16-week-old group performed poorly on the task. The best delayed-response performances were made by puppies belonging to the 12-week-old group. The results of this study seem to provide additional support to the findings of Scott and Fuller, indicating an apparent disruption of learning abilities as puppies approach 16 weeks of age. On average, the 16-week-old puppies made far more mistakes than did the 12-week-old puppies. Fox has speculated that this negative shift in learning ability may be the result of a phasic developmental excitatory-inhibitory imbalance in which excitatory processes temporarily override inhibitory ones. As a result of such excitatory dominance, 16-week-old puppies may be less able to inhibit incorrect responses to the unrewarded box, thus mak-

ing more errors than the neurally balanced 12-week-old group. These findings suggest that puppies pass through an important developmental phase or "terminal maturational processes" of increased excitability at around 16 weeks of age. It also indicates that this period may not be the best time to commence inhibitory training. This shift in ability is temporary, since adult dogs perform better in delayed response than do 12-week-old puppies.

What appear to be somewhat conflicting results concerning the puppies delayed-response abilities have been reported by Gagnon and Dore (1994). In a series of experiments exploring *object permanence* in dogs, a variation on delayed-response testing, the researchers found little difference among dogs between 8 weeks to 9 months of age with respect to their ability to locate objects that had been invisibly displaced as they looked on. Reliable evidence of object permanence was not observed in dogs that were under 11 months of age. The study suggests that a late developmental period occurring at the end of the first year is associated with cognitive elaborations involving object permanence. The researchers found that puppies between 6 and 7 months of age were unable to locate invisibly displaced objects, whereas dogs 11 months and older were regularly successful in their efforts to locate invisibly displaced objects. Dogs between 8 and 10 months of age exhibit mixed abilities with respect to object-permanence abilities. Although tentative, these results suggest the existence of a very significant change in canine cognitive abilities at approximately 11 months. Comparing these results with the earlier findings of Fox and Spencer is problematical. The two studies employ very different experimental designs and, perhaps, measure different cognitive abilities, making conclusions difficult to form regarding their significance for one another.

The quality of secondary socialization taking place after week 12 appears to have a direct bearing on a dog's trainability as an adult. Pfaffenberger and Scott (1959) carried out a socialization experiment involving guide-dog puppies. All the puppies involved were exposed to identical treatment, training, and testing until week 12. During week 12, some of the puppies were removed from the kennel situation and reared in homes under the care of 4-H Club members. Also, at this time, the usual contact between the remaining puppies and the evaluators was terminated. Of the puppies placed in 4-H homes at 12 weeks of age that had successfully passed earlier temperament and intelligence tests, 90% went on to complete guide-dog training successfully at 1 year of age. The remaining puppies were placed in foster homes over the next several weeks at different ages until week 19. The experiment revealed a striking effect: those animals that were placed into homes more than 2 weeks after the close of the socialization period (12 weeks) had a significantly higher rate of failure than puppies that had been placed in homes during week 12 (Fig. 2.12).

Pfaffenberger and Scott argued that this effect was probably due to an abrupt break in the socialization process, rather than the result of some underlying developmental change taking place during the several weeks immediately following the close of the socialization period. Provided that this supposition is accurate, it would seem to indicate that the

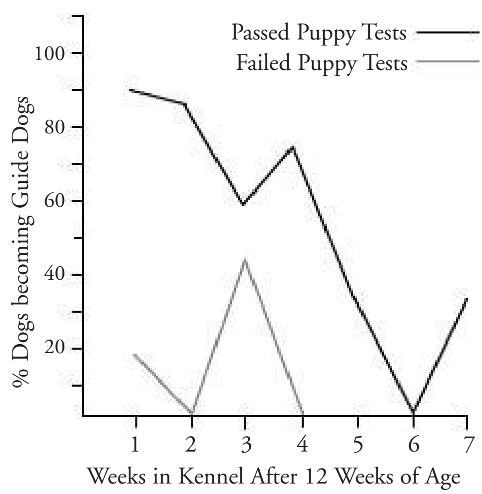

FIG. 2.12. Puppies kept in the kennel after 12 weeks of age were less likely to become guide dogs as adults. This influence was especially marked in puppies failing early "aptitude" tests. After Pfaffenberger and Scott (1959).

benefits of early socialization may be reversible in an especially negative way by abrupt cessation of socialization activities following the conclusion of the socialization period. The phenomenon observed by Pfaffenberger and Scott may be an artifact produced by the superficial socialization efforts carried out prior to week 12. From birth to 8 weeks of age, the experimental group of puppies received only minimal social contact that took place incidental to custodial care. During the period extending from weeks 8 to 12, they received a half-hour of individual contact per week associated with evaluation and various testing procedures. Although a half-hour per week of sustained socialization appears to be enough to produce a normal dog, it may not be enough to produce a puppy able to withstand the effects of abrupt partial isolation. Fox has also noted that the socialization effect is contingent on sustained social contact and may be reversed under conditions of neglect and isolation:

> Although there is an optimal period for socializing pups, there is evidence that dogs may subsequently regress or become feral. The social bond with man may be broken when well-socialized pups are placed in kennels at three or four months of age; by six or eight months they are shy of strangers and often of their caretakers if they have not been handled much. In addition, they may be extremely fearful when removed from their usual quarters. Their fearfulness is the result of a combination of institutionalization and desocialization. (1974:60–61)

This so-called *kennel-dog syndrome* is particularly evident in German shepherds, with the more independent terrier breeds being apparently less susceptible to the negative effects of prolonged kenneling (Scott, 1967).

Imprinting-like Processes and Canine Skill Learning

Imprinting is a learning phenomenon distinguished by three primary characteristics: (1) it requires a small amount of early exposure, (2) it occurs during a relatively short sensitive period, and (3) it exhibits long-lasting and durable effects. The imprinting period is usually bounded by relevant developmental processes. The learning or lack of learning experienced during this impressionable period is largely irreversible. In its broadest sense, imprinting is a process (limited by the aforementioned parameters) whereby an innately prepared species-specific tendency or pattern of behavior is brought under the control of a preferred stimulus, releasing agent, object, or situation. Although imprinting is a learning phenomenon primarily associated with social attachment and identification, its role in the development of complex behavioral patterns is worthy of speculation. Tinbergen (1951/1969) observed that Eskimo dogs in Greenland learned the territorial boundaries of neighboring packs during a fixed "critical" period associated with sexual maturity. Two of the dogs he observed began to defend territory and avoided other territories within 1 week of their first sexual encounters. Prior to this time, the dogs appeared unable to learn not to trespass onto surrounding territories in spite of repeated and severe attacks, a persistence Tinbergen attributes to developmental immaturity. Similarly, many canine skills like retrieving, willingness to stay close during walks, coming when called, and house training appear to have especially sensitive periods for their introduction and training.

For instance, a dog's willingness to fetch an object is definitely influenced by early exposure to retrieving games. If puppies are prevented from engaging in ball play until after week 14 or so, they may not show a significant interest or willingness to engage in activity later on. Although many such dogs can be eventually trained to retrieve, the process is impeded by a lack of early exposure and experience. Scott and Fuller (1965) made a valuable serendipitous discovery about the importance of early exposure for learning retrieving skills by dogs. As the result of logistical constraints, they put off retrieving tests until puppies were 32 weeks of age instead of performing them during week 9 as had been their original plan. The experimenters were surprised by the puppies' poor retrieving scores: only 11% returned the item and released it to their handlers. They also observed

that the 32-week-old puppies were harder to train than those that had been introduced to retrieving earlier, at 9 weeks of age. They concluded that there might exist a critical period for learning to retrieve, "a time when the probability of executing the complete pattern is relatively high, so that reward training can be maximally effective" (Scott and Fuller 1965:219).

Incidentally, the single most reliable indicator of a puppy's general temperament and potential as a companion or working dog is revealed by the puppy's willingness to retrieve. Many "gifted" puppies perform this activity without any previous training and on the first or second try. In my experience, such puppies, all other things being equal, usually develop into excellent companions and working dogs. As an evaluator at Biosensor (U.S. Army Superdog Program), I found that the most reliable predictor among young puppies (8 to 10 weeks) for success as military dog prospects was an avidity for ball play and vigorous interest in rag play. Similarly, Pfaffenberger (1963) reports a strong link between a puppy's willingness to retrieve and later success in training as an adult guide dog. Another highly predictive indicator was a puppy's degree of tolerance toward novel (frightening) moving objects. Failure to fetch a ball or tolerate the approach of a small two-wheeled cart predicted an increased risk of failure in the guide-dog training program.

An area of interest for average dog owners regards active following and coming when called. Long walks consisting of occasional surprise maneuvers, exciting changes of pace, unexpected chase and counterchase episodes, hide-and-seek games, punctuated with occasional opportunities for ball play or stick fetching—all facilitate the learning of appropriate "staying close" skills in puppies. Such interaction strongly stimulates leader-follower bonding and other social components conducive to obedience training. If puppies are not exposed to such experiences during the socialization period, as adult dogs they are typically more difficult to train to come when called or to stay nearby on walks. In contrast, puppies exposed to off-leash walks, playful recall training, and ball play are invariably easier to instruct in the performance of related tasks as adults.

Another behavioral tendency that appears to rely heavily on an imprinting-like processes is house training. There appears to be a narrow window of opportunity between 7 and 9 weeks of age for introducing house training most efficiently. Puppies started during this time tend to do much better and have far fewer accidents than puppies whose training is postponed until later. During this period, puppies develop location and substrate preferences away from their nesting area. Proper house training relies on directing innately programmed tendencies and patterns of behavior into appropriate outlets. If a puppy acquires a preference for eliminating indoors on the carpet or even on papers in the kitchen, it will be more difficult to redirect this activity outside later. Elimination location and substrate preferences appear to be strongly influenced during this brief period and, whenever possible, puppies should be taught to eliminate outdoors from the start, thereby skipping the confusing paper training routine. A good practice on arriving home with a new puppy is to take the puppy first thing to an outdoor area reserved for elimination; the experience will leave a lasting and beneficial impression on the puppy.

Preventing Behavior Problems

Much remains to be learned about the effects of early experience on adult behavior and the development of behavior problems. Growing statistical and anecdotal evidence suggests that very significant influences are at work. For example, a study by Jagoe (see Serpell and Jagoe, 1995) has detected several significant associations between pediatric illness and later behavior problems, including a higher incidence of dominance-related aggression, aggression toward strangers, fear of strangers, fear of children, separation-related barking, and abnormal sexual behavior. The author speculates that excessive and exclusive attention resulting from home medical care and reduced social contact outside of the home contributed to the development of some of these behavior problems. Given this

rather compelling evidence of a relationship between early sickness and later behavior problems, it would seem advisable to offer puppy owners preventative behavioral counseling as part of the overall treatment of serious canine pediatric illness.

Hopefully, in the future, puppy socialization and training courses will become a common feature of puppy rearing—as common and routine as vaccinations are today in the prevention of communicable disease. Early behavioral training and proper socialization appear to "inoculate" immature dogs against many adult dog behavior problems such as hyperactivity, excessive fearfulness, aggression, separation anxiety, and general disobedience. Although "hard" scientific evidence is still lacking, many anecdotal reports and case histories strongly support the value of early training in the prevention of these serious problems. Unfortunately, however, many of the current rearing practices often neglect or incorrectly apply the needed training efforts.

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3

Neurobiology of Behavior and Learning

The possibility of understanding the central neural substrates that govern behavior is exciting not only because it deepens our understanding of humans and of all animal life, but also because it holds the promise that we may someday be able to correct imbalances in behavioral functions or restore functions lost by disease.

G. M. Shepherd, *Neurobiology* (1983)

BEHAVIORAL ADAPTATION depends on the coordinated interaction of many neural and sensory substrates. Together the brain and senses orchestrate what is experienced and what will be learned from experience. Considering the obvious importance of these systems and their fundamental implications for learning, it makes sense to study their various contributions to the development of adaptive behavior.

The operation of a radio is a useful analogy for illustrating the dependent relationship between behavior and the brain. The radio picks up electromagnetic waves from the atmosphere and transduces them into perceptible sound. Its ability to perform this task depends on a number of coordinated and hierarchically arranged systems, including specialized circuitry that sorts out specific radio waves one frequency at a time. This ability might be referred to as afferent selectivity. The selected signal undergoes various processes of electronic conversion and is then amplified into efferent mechanical action——the production of sound by the magnetic vibration of its speaker. Finally, the radio provides the user with several operational features with which to control the quality and quantity of sound produced, for example, tuning, volume, and tone.

To some extent, behavioral systems operate in a similar, although far more complicated, way. Environmental stimuli impinging on an animal are received as raw data by specialized sense organs. The senses afferently select and condition sensory data into sensations, relay them into appropriate neural tracts where they undergo preconscious sorting and analysis, and, finally, the input is cortically transformed into meaningful information, cognitions, emotions, and actions. This neurally processed information prepares the animal to adjust appropriately to current environmental conditions. In every degree and nuance, experience and learning are limited by neural and sensory constraints. The experiencing subject is first and foremost a biologically defined experiencer. To return to the radio analogy, the receiver converts electromagnetic waves into music, but only if it is tuned to the specific frequency carrying the relevant "information." There is no possibility of music being produced unless the receiver intercepts and decodes this electromagnetic information and converts it into an audible dimension. If interference, defective parts, short circuits or any dysfunction whatsoever occurs within this highly organized system, the music produced will be adversely affected or, perhaps, completely lost. Similarly, neurosensory systems define the sort of input that will be received and to a large extent how it will be acted on. The neurological substrates, for example, controlling stimulus-response processing depend almost entirely on such *hardwired* mechanisms.

The operation of the radio set also metaphorically parallels the limited variability of innate behavioral systems. The mechanisms controlling signal selection, volume, and tone are all ways in which a radio can be adjusted to a listener's pleasure. Learning mechanisms are themselves biologically prepared and accessible for manipulation only under special conditions and within a limited range of variability defined by functional constraints. Training and behavior modification are largely limited to response selection (i.e., stimulus control) and the shaping of behavior (tuning), augmentation or suppression of behavior (volume + or −), and the modification of emotional states and the stimulus-response thresholds controlling them (tone control). But unlike the simple and immediate response of the radio, external control of behavioral systems requires far more persistent and skilled effort. In general, behavioral systems are reluctant to change without compelling need.

Behavioral adjustment depends on learning, but learning is possible only to the extent that an animal is biologically equipped and prepared to learn. The organization of behavior is genetically programmed to be flexible and variable but only to a certain extent and according to more or less fixed laws and parameters of change defined by the brain and senses. In essence, the brain and senses biologically define the limits of what an animal can learn and how it can learn it, while experience dictates the moment-to-moment direction of these changes. Survival de-

pends on an animal's ability to learn from its experiences, to adjust its behavior in accordance with what it has learned, and to form a set of reliable predictions and strategies of control that enable it to encounter similar circumstances most effectively in the future.

The subject of brain anatomy and function is highly complex but very valuable for understanding the basic processes of behavior, emotion, and learning. The following discussion has been largely restricted to areas of practical significance for trainers or behaviorists working with adjustment and behavior problems in dogs.

Cellular Composition of the Brain

Neurons

In contrast to the simple radio receiver, the dog's brain is a profoundly complicated organ consisting of billions of neurons and interconnecting neural circuits. The neuron shares many of the same basic biological functions exhibited by other cells of the body. One notable exception to this generality is the neuron's inability to replicate. Shortly after birth, neurons stop dividing in the dog's brain and thereafter no new neurons are produced. Consequently, injuries to the brain involving direct trauma or anoxia may be very serious—and permanent—since lost neurons cannot be replaced. Although neurons may be more or less specialized, their structure and function are remarkably similar. Basically, the neuron is designed to send and receive information. These functions are facilitated by structural components called axons and dendrites. The axon is an elongated projection of the neuron that carries messages away from the cell body (efferent messages) while dendrites carry the message toward the cell body (afferent messages). Transmissions occur at locations where axons form connections with other neurons. These points of transmission are called synapses.

The synapse is a narrow cleft between the transmitting axon and the receiving dendrite. This gap is bridged by the secretion of various chemical neurotransmitters released by the neuron when it is appropriately stimulated. Excitatory and inhibitory synapses compete for dominance over the target neuron. Depending on whether inhibition or excitation is dominant, the neuron either remains quiet or is excited, evoking an axonal depolarization or action potential. As the result of excitation, an electrical charge moves rapidly down the length of the axon to the presynaptic terminal. Once arriving at the presynaptic terminal, the charge triggers the release of specific neurotransmitters into the synaptic cleft, thereby stimulating adjacent dendrites belonging to target neurons. Movement of this electrical charge is accelerated by a thin insulating substance called myelin that covers the length of the axon. The foregoing cycle of excitation, depolarization, and release of neurotransmitters is repeated in countless neurons until the signal completes its circuit.

Glial Cells

The majority of cells composing the brain are glial cells. Besides providing structural support for neurons and their interconnections, the glia serve many additional functions. An important glial function is to absorb vagrant neural substances (including neurotransmitters) and to dispose of cellular debris associated with injury or the death of neurons. Astrocytes are star-shaped cells that perform these "housekeeping" functions. Astrocyte activity is especially intense at the sites of brain injury. Another very important function of glial cells is the production of myelin sheathing and the formation of the blood-brain barrier.

Myelin is a fatty substance that insulates the axon. It is produced by specialized glial cells called oligodendrocytes (brain axons) and Schwann cells (peripheral nerves). The myelin sheath is discontinuous, having small gaps or nodes of Ranvier regularly spaced about a millimeter apart from each other. The action potential produced by the chemoelectrical excitation of the neuron moves rapidly along the axon by jumping from node to node. Myelin sheathing significantly increases the speed at which the neural impulse is able to travel. At birth, many brain

and peripheral axon fibers lack functional myelination (Fox, 1966). Myelination follows a developmental course in which necessary functions like ingestion are myelinated at birth, whereas fibers associated with less immediately vital functions like hearing and vision are incompletely sheathed. The optic nerve, for instance, is only slightly sheathed with myelin at birth but attains adultlike myelination by about 3 weeks of age, whereas sensory tracts associated with taste and smell are well myelinated at birth in the dog.

Neurons are protected from substances in the blood by a cellular layer composed of astrocytes that surrounds blood-bearing capillaries. Additionally, capillaries in the brain are not as freely permeable as those of other parts of the body and do not allow the passage of large molecules across their walls. The net result is selective transport of only certain necessary nutritional molecules (e.g., glucose and amino acids) and dissolved gases like oxygen and carbon dioxide. Interestingly, portions of the hypothalamus are not protected by the blood-brain barrier (the portal blood supply), due to its homeostatic and bioregulatory functions, which require direct monitoring of blood content (Reese, 1991).

HINDBRAIN AND MIDBRAIN STRUCTURES

The dog's nervous system is divided into two major parts: the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS includes the brain proper and the spinal cord (Fig. 3.1). The PNS encompasses all nervous processes extending beyond the spine and skull, including a subsystem called the autonomic nervous system (ANS). The ANS is composed of two antithetical but complementary branches: the sympathetic and parasympathetic. The ANS is intimately involved in regulating basic bodily processes and in the mediation of the physiological expression of emotion and distress. Later in this chapter, autonomic functions are discussed in detail, since they appear to play a very significant role in the elaboration of disruptive stress and maladaptive behavior.

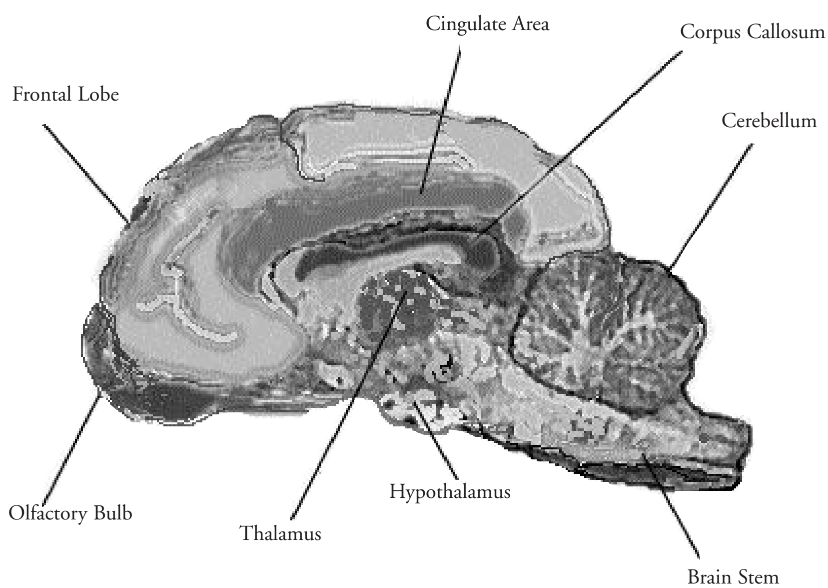

FIG. 3.1. Medial view of the dog's brain. Note the comparatively large olfactory bulb, providing the dog with the neural means to detect and analyze olfactory information.

Medulla Oblongata, Pons, and Cerebellum

The hindbrain consist of the medulla, pons, and cerebellum. The medulla is a primitive brain structure located just above the spinal cord and regulates many vital biological functions, such as the control of heart rate, respiration, gastrointestinal functions, salivation, coughing, and sneezing. Together with the pons, the medulla is an important relay site for auditory and vestibular information, gustatory sensations and associated motor reactions, and information about various visceral states. The central portion of the hindbrain contains the reticular formation, a network of interconnected neurons that is associated with wakefulness and generalized sensory arousal.

An important function of the hindbrain is the synthesis of monoamine neurotransmitters. Serotonin-producing cells are located in the raphe bodies, a narrow strip of specialized neurons in the hindbrain, extending from the medulla to the midbrain. Norepinephrine (NE) is made by a group cells in the pons called the locus coeruleus, an area with highly pigmented blue neurons (Ranson and Clark, 1959). Whereas NE is associated with wakefulness and learning, serotonin appears to play an important role in the activation of sleep and the modulation of various inhibitory processes.

The cerebellum, a brain structure associated with "automatic" coordinated movement and sensory processing, is interconnected via thalamic relays with the sensory-motor areas of the cerebral cortex. These interconnections form a complex loop of ascending projections from the cerebellum to the motor cortex and, subsequently, from the motor cortex descending back to the cerebellum via pontine nuclei. Cerebellar lesioning results in uncoordinated and awkward movement. Although the cerebellum plays a minimal role in higher conscious functions, the lateral portion of the cerebellum appears to be involved in certain cognitive and memory functions, especially in the mediation of skilled motor performances and aversive conditioned responses (Lavond et al., 1993). Interestingly, the only output from the cerebellar cortex is inhibitory, which is mediated via axons of specialized Purkinje cells. The Purkinje cells are large GABAergic neurons [the primary neural effect of GABA (gamma-aminobutyric acid) is inhibitory]. The inhibitory Purkinje cells project to highly active and excitatory subcortical nuclei, exerting a modulatory and regulatory effect on these neurons whose fibers ultimately project to higher motor brain centers.

Reticular Formation

The reticular formation is a brain stem structure extending from the medulla to the thalamus. The primary function of the reticular formation is the maintenance of a state of generalized neural arousal and alertness. Many projections leave the reticular formation and extend throughout the limbic system and cerebral cortex. This system of diffuse reticular fibers is referred to as the ascending reticular activating system (ARAS). In addition to its arousal functions, the ARAS is also believed to mediate an integrative effect on the nervous system. Electrical stimulation of the reticular formation of a sleeping dog results in the dog's arousal and awakening. On the other hand, lesioning of the reticular formation results in a permanent comatose or sleeplike state. Besides the arousal and attentional functions of the ARAS, the reticular formation also receives and gates sensory inputs, apparently mediating increased excitement and arousal resulting from peripheral sensory transmissions relayed through it. Unlike the corticothalamic relays where more specific sensory sorting, routing, and information processing takes place, the reticular formation is concerned with the general enhancement of alertness and excitability caused by these sensory inputs and the subsequent elaboration of a nonspecific orienting response to them. The auditory tract sends collateral axonal fibers directly into the reticular formation, perhaps accounting for the rapid and intense orienting responsiveness dogs exhibit toward novel sounds.

Gray (1971) has speculated that the ARAS

is especially well connected with sensory tracts associated with pain. He reports studies carried out by James Olds in which direct electrical stimulation of various portions of the ARAS (especially the periventricular areas) resulted in the evocation of escape and other pronounced behavioral expressions evidencing pain and discomfort. According to Gray (1971), the midbrain ARAS may play an important role in the arousal and activation associated with punishment or frustrative nonreward. Electrical stimulation of the midbrain reticular formation results in a direct potentiation or strengthening of ongoing behavior in a manner similar to that observed during punishment or frustrative nonreward.

Arousal resulting from activation of the reticular formation probably depends on the neurotransmitter NE. Inescapable trauma and prolonged stress result in the depletion of NE, and NE depletion is associated with learned helplessness (Seligman, 1975) (see Chapter 9). Seligman reviews some of the relevant physiological literature indicating that learned helplessness and collateral symptoms of depression may be linked to adrenergic depletion. Some disagreement in the literature exists with regard to the importance of NE and dopamine in the production of pleasure and reward. Thompson (1993) and many others attribute the brain's reward-and-pleasure system to dopaminergic activity. An important area for the elaboration of pleasure is the medial forebrain bundle (MFB)—a major ascending pathway of various neurotransmitters, including serotonergic, adrenergic, and dopaminergic fibers. Siegel and Edinger (1981) emphasize the importance of the MFB as a conduit for *adrenergic* fibers originating in the locus coeruleus and projecting into the lateral hypothalamus and amygdala. Animals stimulated with electrodes inserted into the MFB act as though they were actually eating, drinking, and copulating, that is, appearing to be rewarded by the consumption of the corresponding but absent reward item (viz., food, water, and sex). However, drugs that block dopaminergic activity also apparently inhibit the pleasure resulting from electrical stimulation of these areas (White and Milner, 1992). Animals operantly trained to perform a bar-press response for intracranial stimulation of MFB sites quit when dopamine levels are reduced. According to this theory, a dopaminergic pathway exists between the MFB and the ventral tegmentum and terminates in the nucleus accumbens. Precise stimulation of the nucleus accumbens (located in the forebrain, anterior to the hypothalamus) produces all the effects observed during electrical stimulation of the MFB, suggesting that earlier studies may have confounded dopamine and NE pathways. Most authorities currently believe that reward is most likely mediated by dopaminergic systems. However, modulating NE pathways may play a significant role in the experience of pleasure and reward via enhanced alertness, mood, and feelings of well-being affected by NE activity. Low levels of dopamine in the brain result in a loss of affect and positive feelings, whereas low levels of NE result in depressed mood and a sense of helplessness (Seligman, 1975).

DIENCEPHALON

Thalamus

The thalamus coordinates sensory and emotional inputs, serving as a gateway and relay between the body, limbic system, and cerebral cortex. Thalamic relay nuclei coordinate the projection of sensory information from the body and sensory organs, directing it to the appropriate somatosensory portions of the cerebral cortex—the most recent and "conscious" addition to the brain. The amount of the cortex reserved for any particular body area or function depends on its overall use, sensitivity, and relative importance for the animal's survival. Further, the area of the cerebral cortex allotted to any particular function corresponds proportionately to the relative size of the thalamic sensory nuclei relaying to it. Animals can be categorized into three basic types depending on which sensory function dominates: beholders, feelers, and listeners (Welker, 1973). Within this scenario, dogs probably fit into the listener-type category, indicating that a disproportionately large area of the canine cortex and thalamus is devoted to the representation and analysis of auditory information.

Besides relaying sensory and emotional input, the thalamus plays an important role in the expression of attentional behavior. In contrast to the general arousal functions served by the reticular formation, the thalamus mediates a more selective, "informed" attentional response toward sensory inputs. The thalamus enables a dog to selectively concentrate and focus on one thing at a time, whereas the reticular formation facilitates general alertness, causing all sensory inputs reaching an effective threshold to capture attention.

Unlike all other sensory inputs, which travel first to the thalamus before being relayed to other parts of the brain, olfactory sensory input moves directly from the olfactory bulb via the olfactory tract to the primary olfactory cortex (paleocortex). From the olfactory cortex, the olfactory input projects to the medial dorso nucleus of the thalamus, from where it is relayed to neocortical destinations (orbitofrontal cortex) for cognitive (associative) processing and the conscious perception of smell. A second major olfactory pathway originating in the primary olfactory cortex projects to the preoptic/lateral hypothalamus. Another important limbic destination of olfactory information is the amygdala. The corticomedial nucleus of the amygdala receives afferent input directly from the olfactory bulbs as well as forming connections with the olfactory cortex. Secondary olfactory projections terminate in various other related limbic areas, including the septum and hippocampus (Thompson, 1993). Clearly, many areas of the dog's brain receives olfactory information via parallel and interacting circuits. These various neural circuits serve such diverse functions as food and mate selection, kinship recognition, sexual behavior, memory, imprinting, motivation, emotion, and learning. Not surprisingly, a proportionately larger area of a dog's brain than the human brain is devoted to analyzing olfactory information.

Hypothalamus

The hypothalamus performs many regulatory functions over basic biological activities, including appetite, thirst, and various homeostatic functions like blood pressure, temperature regulation, and blood sugar levels. Besides controlling basic appetitive/homeostatic drives and regulating the expression of emotional behavior, hypothalamic nuclei also control sexual drive. Hypothalamic activity is intimately connected with the endocrine system and the regulation of the pituitary gland—the so-called master gland of the body. The hypothalamus exercises direct *chemical* regulatory control over the pituitary by the manufacture and secretion of releasing factors. Hypothalamic releasing factors circulate via the portal blood supply to the anterior pituitary, causing it to release various tropic hormones involved in growth, sexual behavior, maternal behavior, metabolism, and general biological stress reactions. The hypothalamus also controls the ANS, which is composed of two subsystems: the sympathetic nervous system and the parasympathetic nervous system. Together the sympathetic division and parasympathetic division perform numerous complementary functions designed to achieve biological homeostasis (Fig. 3.2). The sympathetic division provides immediate physiological preparation for emergency freeze-flight-fight reactions. Sympathetic arousal is regulated by the posterior hypothalamus, which when appropriately stimulated evokes a bodywide neuroendocrine preparation for vigorous action. Besides directly activating the biological systems needed for emergency action, sympathetic arousal stimulates the adrenal medulla to release the peripheral hormones epinephrine and NE into the bloodstream. Epinephrine reinforces and sustains ANS-triggered stimulation of such stress-related bodily changes as increased heart rate and respiration. This interaction between the hypothalamus and the adrenal medulla is known as the sympathetic-adrenomedullary system.

A neuroendocrine system associated with stressful arousal and homeostasis is formed by the hypothalamus, pituitary, and the adrenal cortex. Under conditions of stress, the hypothalamus secretes corticotropin-releasing factor (CRF), which signals the pituitary gland to secrete a tropic hormone—adrenocorticotropic hormone (ACTH)—into the bloodstream. ACTH stimulates the adrenal cortex

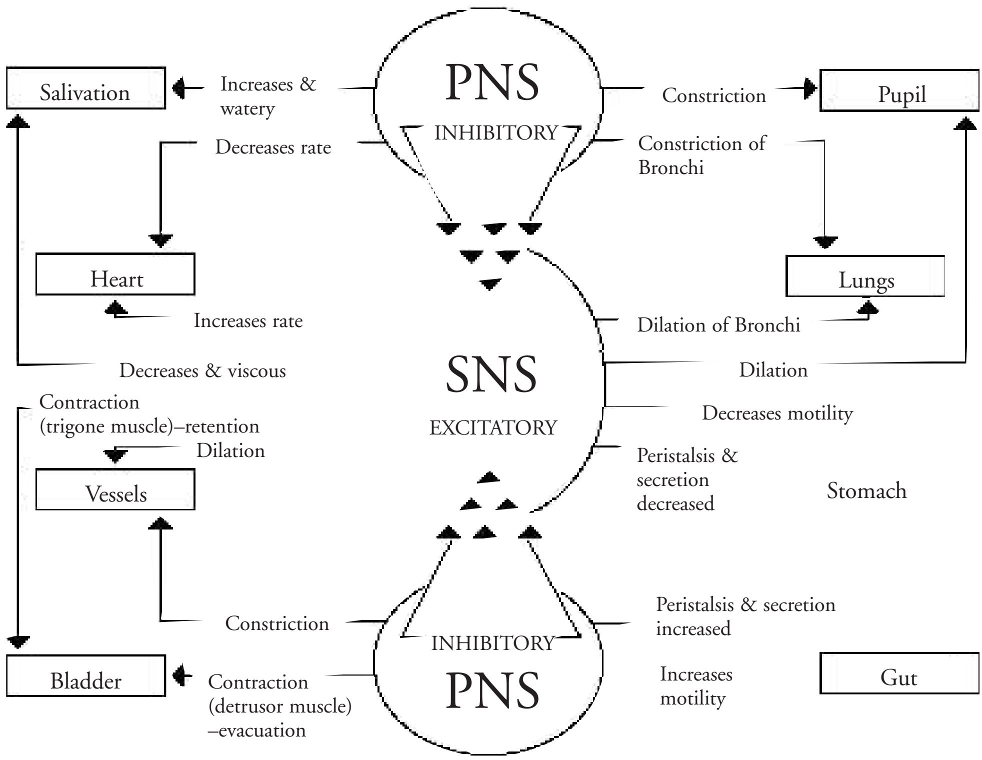

FIG. 3.2. Examples of complementary autonomic action produced by the interaction of the parasympathetic nervous system (PNS) and the sympathetic nervous system (SNS). The checks and balances between the PNS and SNS strive to achieve biological homeostasis.

to release various steroidal hormones, including cortisol (corticosterone). Cortisol serves many biological functions (regulation of blood pressure, control of glucose levels in the blood, and acceleration of the breakdown of protein into amino acids) to help an animal cope effectively with stress, injury, or defense. The release of cortisol into the bloodstream completes the circuit when it reaches the hypothalamus, where it restrains CRF production and thereby inhibits ACTH production by the pituitary. The reduction of circulating ACTH causes the adrenal cortex to decrease production and secretion of cortisol. This slower stress-activated system is known as the hypothalamic-pituitary-adrenocortical (HPA) system.

The parasympathetic branch of the ANS shadows the actions of the sympathetic system, but with an opposing calming influence more specifically targeted on the various organs and systems of the body activated by the sympathetic division. Although autonomic activity is aimed at achieving homeostatic balance of sympathetic and parasympathetic influences, some individuals appear to be genetically predisposed in one direction or the other (Kagan et al., 1987; Kagan and Snidman 1988). Some dogs are sympathetically dominant (prone to emotional reactivity and biological stress), whereas others, the parasympathetically dominant type, are inherently more calm and enjoy a more precise biological adaptation. The sympathetically dominant temperament type is more prone to develop behavior problems involving emotional reactivity and psychosomatic disorders than the parasympathetically dominant counterpart. Tests devised to evaluate relative sympathetic versus parasympathetic ANS reactiv-

ity in puppies could be potentially useful in conjunction with puppy temperament-testing procedures. Measures of heart rate, blood pressure, respiration, and cortisol levels under various conditions of stress could provide a reliable means to assess ANS dominance and temperament reactivity.

Gunnar (1994) reviewed several studies showing a correlation between cortisol levels and relative dominance-assertiveness in young children. This correlation is an interesting finding, since HPA activation is generally associated with emotional distress and fear. She reports an experiment performed by de Haan and colleagues (1993) demonstrating a direct relationship between dominance-aggressiveness and cortisol levels in 2-year-old children. In this experiment, salivary cortisol levels were measured during the first few days of nursery school. Subsequent interviews with the teacher and parents of the children tested revealed several positive correlations between high cortisol levels and a child's tendency to become a group leader, engage in aggressive behavior in school, and exhibit an "angry temperament" at home. On the other hand, more socially retiring children exhibiting shyness, with a tendency toward solitary play, and other signs of behavioral inhibition did not show significant cortisol indicators of HPA system arousal.

Studies with various animal species have shown a link between increased HPA system activity and stress. Sapolsky (1990) studied the dynamic interaction between social status, the stress response, and a variety of correlated hormonal changes exhibited differentially by dominant and subordinate free-ranging baboons. He found that resting cortisol levels are higher in subordinate males, but that, under acute stress, cortisol levels in dominant males overshoot that exhibited by subordinates under the same conditions:

> Cortisol is responsible for much of the double-edged quality of the stress response. In the short run it mobilizes energy, but its chronic overproduction contributes to muscle wastage, hypertension and impaired immunity and fertility. Clearly, then, cortisol should be secreted heavily in response to a truly threatening situation but should be kept in check at other times. This is precisely what occurs in dominant males. Their resting levels of cortisol are lower than those of subordinate males yet will rise faster when a major stressor does come; exactly how this speedier rise is accomplished is not understood. (1990:120)

Similarly, Manogue and colleagues (1975) found that, among squirrel monkeys, individuals destined to play a dominant role in the group exhibited higher cortisol levels than subordinates during the early phases of the group's organization. Once the group became stable, the dominant monkey's cortisol level dropped below that of the subordinates. Under conditions of external distress, however, the dominant monkey exhibited emergency cortisol levels that quickly overshot that of subordinate group members. McLeod and coworkers (1995) have shown that urinary cortisol levels are increased under the influence of social stress among captive wolves. For example, they found that the lowest-ranking females exhibited the highest levels of cortisol in their urine. The presence of high levels of cortisol in the urine of subordinate females may help to account for the natural inhibition of estrus in such females via stress-mediated suppression of hypothalamic secretion of gonadotropin-releasing hormone. Haemisch (1990) investigated cortisol levels in guinea pigs undergoing social conflict in familiar and unfamiliar environments. Under conditions of social conflict occurring between an offensive individual and defensive individual, the defensive guinea pig exhibited significantly higher levels of plasma cortisol (about four times as much) under familiar environmental conditions than the offensive animal. When confrontations took place in an unfamiliar environment, the difference between the offensive and defensive individuals was not significant.

A study involving HPA activity in pointers found that genetically nervous dogs possessed significantly larger adrenal glands than normal controls (Pasley et al., 1978). Adrenal hypertrophy is commonly associated with chronic HPA-mediated stress. However, a subsequent experiment performed by Klein and colleagues (1990) failed to show a significant difference between nervous and normal pointers in terms of HPA system activity. The

authors speculate that the lack of difference between the two strains of pointers may have resulted from the testing method employed (a static single-point baseline comparison), which may have missed significant differences in HPA activity occurring episodically at other times during the day. Another interesting finding relevant to hypothalamic-pituitary interaction involves differences in somatomedin/insulin-like growth factor (IGF-I) levels found in nervous and normal pointers (Uhde et al., 1992). Nervous dogs exhibit lower plasma levels of growth factor (GF) than normal controls. Nervous dogs appear to be smaller, perhaps a direct physical outcome of GF insufficiency. Further, nervous pointers are more prone to exhibit compulsive behaviors (especially oral ones like excessive licking, biting, and pulling) than normal pointers. Uhde and colleagues suggest that replacement GF might provide some therapeutic benefit for acral lick dermatitis (to date, an untested possibility).

Intense sympathetic arousal may precipitate pronounced parasympathetic rebound effects like diarrhea and urination resulting from increased alimentary and urinary motility. Another common outcome following intense sympathetic arousal is opponent-processed parasympathetic reduction of heart rate. Church and colleagues (1966) demonstrated that dogs stimulated with shock experience an initial sharp rise in heart rate (sympathetic arousal), but with the cessation of shock the subjects' heart rates fall far below their original quiet preshock levels. Konorski (1967) reported experiments in which a dog and several rabbits were caused to experience intense fear by being shot with noninjurious paper projectiles from a sham gun. Whereas the dog experienced an increase in blood pressure after being shot, the rabbits exhibited a sharp fall in blood pressure, with some experiencing an increase after the cessation of stimulation. A few of the stimulated rabbits died as the result of a precipitous and lethal fall in blood pressure. Another relevant study with respect to parasympathetic rebound effects on cardiac function was performed by Richter (1957), who immersed rats in water and observed their swimming behavior under various experimental conditions. One group of swimmers had their whiskers (vibrissae) cut off before being placed in the swim tank. In rats, the whiskers are a very important sensory accessory for providing information about their immediate surroundings. According to Welker's nomenclature, previously discussed above, rats are *feelers* whose thalamocortical world is dominated by sensory information provided by the whiskers. The rats without whiskers panicked, apparently responding to the tank situation as though it were inescapable without the aid of whiskers; they swam frantically for a minute or so, before giving up and sinking to the bottom of the tank. Subsequent necropsies showed that the rats had not drowned but had suffered cardiac arrest. Ordinarily, rats can swim for long durations without stopping (up to 48 hours). The dewhiskered rats, however, were seized with intense sympathetic activation rapidly followed by an equal but opposed parasympathetic rebound, resulting in the loss of heart activity. In subsequent studies, Richter found that if he repeatedly immersed and rescued a rat before cutting off its whiskers, the animal did much better than controls not pretreated before exposure to immersion. Pretreated rats appeared to be partially immunized against an apparent "helplessness" effect generated by the removal of their whiskers.

LIMBIC SYSTEM

The limbic system is a complex loop of neural structures and circuits involved in the expression and experience of emotions. This pervasive and influential system also plays an important role in learning and memory. The primary structures composing the limbic system include the amygdaloid complex, the septohippocampal system (septal area and hippocampus), the diencephalon (hypothalamus and thalamus), and the limbic cortex. The limbic system has been investigated primarily by observing the effects of intracranial electrical or chemical stimulation or ablation of target areas (Table 3.1).

The limbic system appears to have evolved out of primitive structures involved in the analysis (intensity, quality, and direction) and interpretation of olfactory information. This

TABLE 3.1. Behavioral and emotional effects produced by stimulating or destroying various limbic areas

Limbic areas	Stimulation	Destruction
Cingulate gyrus	Tameness or aggression	Fearlessness (dog)
Thalamus		
Paramedian	Relaxation, sleep	—
Ventrolateral	—	Apathy
Midline	Affective aggression	—
Anterior	—	Docility
Dorsomedial	—	Rage
Hypothalamus		
Ventromedial nucleus	Hypophagia	Hyperphagia, rage (dog), affective aggression
Dorsomedial	Affective aggression	—
Posterior area	Alertness, excitement (dog)	Inactivity, sleep (dog)
Anterior area	Sleep (dog)	—
Lateral area	Quiet (predatory) attack; induces drinking and eating	Reduced affective aggression, adipsia, asphagia (dog)
Amygdala	Fear, wariness, affective aggression (dog)	Tameness, docility, passiveness (dog)
Septum	Defecation, urination, tameness, hypersexuality	Irritability, rage, reduced fearfulness (dog)

Source: From Swenson (1984) and Hoerlein (1971).

function of the limbic system is especially evident in reptilian species, in which the limbic system provides vital olfactory information regulating appetitive and sexual behavior, as well as various agonistic displays. In higher vertebrates like dogs, the limbic system has been diversified to serve a number of new and more complex emotional functions.

Among many other activities, interpretive olfactory functions are still performed by the amygdala. The amygdala is an almond-shaped complex of nuclei embedded in the white matter of the temporal lobe, just below the cortex and anterior to the hippocampus. The nuclei forming the amygdala are divided into three main groups: the basolateral nuclei (receive relayed sensory inputs from the thalamus as well as analyzed sensory inputs from the cortex), corticomedial nuclei (receive afferent inputs from the olfactory bulb and mediate higher cortical analysis of olfactory information), and the central nucleus (projects to the brain stem and hypothalamus and mediates the expression of fear). The amygdala is interconnected with the hypothalamus by a bundle of fibers called the stria terminalis and a collection of fibers called the ventral amygdalofugal pathway.

In dogs and other mammals, the amygdala mediates the expression of fear and the modulation of aggression. Electrical stimulation of certain areas of the amygdala evokes intense vigilance together with generalized fear or rage reactions. On the other hand, surgical removal of the amygdala results in hyperactivity, marked hypersexual interest, compulsive orality, and a loss of fear and aggressiveness. Previously fearful or aggressive animals are "tamed" by amygdalectomy, allowing contact and petting without visible signs of nervousness or fear. Moyer reports a dramatic reduction in fear in an amygdalectomized rat:

> Normal albino rats freeze and remain immobile in the presence of a cat even though they have had no prior experience with that animal. However, if the rat is amygdalectomized, its behavior in the presence of the cat is not inhibited and it approaches the cat without reluc-

> tance. In one case an amygdalectomized rat climbed onto the cat's back and head and began to nibble on the cat's ear. The resultant attack by the cat only momentarily inhibited the rat, which again crawled back on the cat's back as soon as it was released. (1976:257)

Many neurons found in the amygdala exhibit a low threshold of excitability and are prone to seizure, with collateral cortical irradiation and possible loss of conscious awareness. Dogs undergoing psychomotor seizure activity may exhibit a pronounced and unpredictable pattern of periodic explosive aggression followed by disorientation. Seizure activity in the amygdala has been associated with the development of psychomotor epilepsy. With the use of electroencephalograms (EEGs), abnormal electrical activity has been identified in the amygdala of aggressive persons. It does seem reasonable that some seizure activity in the amygdaloid complex could result in heightened aggressiveness, vigilance, intolerance, disorientation, and the periodic exhibition of inappropriate explosive rage. A study by Holliday and coworkers (1970) of epilepsy in dogs confirms that epileptic dogs frequently exhibit collateral abnormal behavior (sometimes as their most prominent symptom), including episodic rage, voracious appetites or inappetence, inappropriate vocalizations, aimless pacing and circling, viciousness toward inanimate objects, intense fearful reactions, persistent licking movements, restlessness, and "apparent blindness." Although psychomotor seizure activity may be associated with collateral aggressive behavior (Borchelt and Voith, 1985), aggressive behavior is infrequently diagnosed as a direct symptom of organic disease (Parker, 1990).

Moyer (1976) reports several studies indicating that the amygdala plays an important role in the modulation of predation and other forms of aggression in various animal species, probably through the modulation of fear. Electrical stimulation of different areas of the amygdala either inhibits or excites predatory behavior. Similarly, other amygdaloid locations modulate (differentially inhibit or excite) irritable or fear-induced aggressive displays. For instance, lesions in the central nucleus produce a lower threshold for irritable aggression in dogs. Once provoked, such aggression appears to escalate quickly without signs of fear or escape. In dogs, the spontaneous attack that is observed in cats with identical amygdala lesions (such cats attack conspecifics without any provocation from the target) does not occur. Instead, dogs exhibit increasing signs of irritability and frustrative arousal that quickly builds up and finally precipitates a full-blown and intense rage response—an *avalanche syndrome* (Fonberg, reported in Moyer, 1976). These behavioral changes suggest that the central nucleus may exercise a strong inhibitory influence (fear) over affective-irritable aggression, with disinhibition occurring when it is damaged.

The amygdala works in conjunction with other limbic structures, cortical association areas, thalamic nuclei, hippocampus (providing memories and context specificity to fear responses), and basal ganglia (giving the amygdala *effector* access to species-typical motor programs). As noted above, the amygdala also forms direct and diverse connections with the hypothalamus, including hypothalamic nuclei that control blood pressure, secretion of stress hormones, and the startle response (LeDoux, 1996). The majority of these projections are bidirectional with target structures projecting back to the amygdala, providing a switchboard of interchange between these various areas of the brain. The result is a system of checks and balances over amygdaloid functions, including the display of aggression and fearfulness. In addition to fear, the amygdala appears to play an important role in the mediation of social behavior and motivation. Fonberg and Kostarczyk (1960) observed various changes in the social motivation and behavior of dogs after lesioning the dorsomedial amygdala and/or the lateral hypothalamus. In addition to the expected loss of appetite, the dogs lost their ability to show normal social responsiveness to people, expressed no emotion, made no physical contact or effort to look at people, were unresponsive to petting and would often move away when being petted, lost their normal tail-wagging behavior, were easily distracted, were apathetic and slow moving, and, in general, were indifferent to the social environment. Apparently, the lesioned dogs

lost their ability to derive pleasure from social interaction.

As is discussed in more detail later in this chapter, the amygdala appears to play a central role in emotional learning (LeDoux, 1994). This function is facilitated by a number of amygdala afferent inputs (basal and lateral nuclei) and efferent outputs (central nucleus) projecting to various somatomotor and autonomic areas controlling the expression of fear in the hypothalamus. The role of the amygdala in the classical conditioning of fear has been demonstrated in a variety of animals and situations (Davis, 1992). Most of these experiments have involved intracranial electrical stimulation or the lesioning of specific areas of the amygdala. Other studies have evaluated the effects of neurotransmitters, agonists, and antagonists on the learning of fear. For example, NE has been implicated in the learning of conditioned fear responses (Lavond et al., 1993). Injecting an NE antagonist (propranolol, a beta blocker) into the amygdala after avoidance training disrupts the subsequent performance of the previously learned avoidance task. Also, naloxone (an endogenous opioid antagonist) injected directly into the amygdala enhances the acquisition of avoidance behavior. The explanation for this improvement, however, does not rest on a direct effect of naloxone on amygdaloid activity but on an indirect causation involving the suppression of endogenous opioid activity. Apparently, endorphins interfere with the release of NE in the amygdala during avoidance training. Microinjections of an opioid agonist (levorphanol) also retard avoidance learning, providing additional support for the foregoing account. Ablation of the amygdala disrupts the acquisition and maintenance of avoidance learning. Previously learned avoidance responses are either quickly extinguished after amygdalectomy or may require greater aversive stimulation to be elicited (Thompson, 1967). On the other hand, stimulation of the central nucleus evokes many autonomic reactions correlated with fear: increased heart rate, respiration, and blood pressure. Such stimulation typically results in the inhibition of ongoing behavior and evokes various facial and motoric expressions associated with fear. The constellation of fearful responses evoked by amygdaloid stimulation is innately programmed and not dependent on learning for its full expression. What is acquired or learned is the range of stimuli and situations able to elicit them.

Conditioned emotional responses are learned when a neutral stimulus (e.g., a tone) is paired with an unconditioned fear-eliciting stimulus (e.g., shock). After a number of pairings in which the conditioned stimulus (CS) and unconditioned stimulus (US) are presented in a close temporal order, the CS will gradually acquire the ability to elicit the fear response without the presentation of the US. This connection between the CS and the US appears to be mediated by the amygdala in conjunction with the thalamus and other related brain sites. Lavond and colleagues (1993) reported a series of studies showing that the classical conditioning of foot-shock reactions (freezing reactions and increases in blood pressure) depends on the participation of various ancillary structures involved in the process of associating conditioned and unconditioned stimuli. Animals with lesions to auditory nuclei projecting from the thalamus (medial geniculate nucleus) to the amygdala fail to learn tone-foot-shock associations but readily learn a light-foot-shock association. Similarly, animals with hippocampal lesions fail to acquire context-foot-shock associations but still learn the tone-foot-shock association. Efferent projections from the amygdala to the hypothalamus also play an important role in classical conditioning of fear reactions. Lesions of the hypothalamus result in both the elimination of conditioned freezing and conditioned blood pressure responses.

In addition to amygdala-hypothalamus interactions, the expression and experience of emotion appear to require the collaboration of several limbic areas, collectively referred to as the Papez circuit (see below). This process begins with emotionally primitive inputs originating in the hypothalamus. These emotional inputs are projected to the anterior thalamus, where they undergo further elaboration and are in turn relayed via the thalamocortical pathway into the limbic cortex (e.g., the cingulate area). It has been speculated that the limbic cortex provides a kind of

neural "screen" organized to receive and bring to awareness primitive emotional impulses originating in the diencephalon. An analogous relationship holds between a film projector and its receiving screen. Just as the image produced by the projector requires a screen to capture and focus its contents, the limbic cortex receives, transforms, and brings to awareness the emotional impulses generated by the hypothalamus. Prior to reaching the limbic cortical areas, emotional input lacks a hedonic quality and an *experienced* subjective content.

Besides its apparent role in the experience of emotion, the cingulate area appears to play a role in the regulation of motor activity. Stimulation of the anterior cingulate area excites motor activity, whereas stimulation of the posterior cingulate area inhibits it. The cingulate gyrus also appears to play an important role in the exhibition of sexual behavior. In males, cingulate lesions result in a reduction of sexual drive, whereas similar lesions in females have no effect on sexual drive but will disrupt maternal behavior, including patterns of nursing and audiovocal communication maintaining mother-progeny contact. Additionally, the cingulate appears to serve an important function in the facilitation of play (MacLean, 1986). The development of maternal behavior, distress vocalization, and play are limbic hallmarks differentiating the mammalian brain from that of the reptile. The reptile brain lacks a structure equivalent to the cingulate gyrus. An important implication of MacLean's work for dogs is the putative localization of separation-distress vocalization within the anterior cingulate gyrus.

Another limbic structure of interest is the septal area—a putative reward center. In humans, electrical stimulation of the septum results in the pleasurable sensation of building to, but never realizing, orgasm. Whereas the amygdala is largely involved with the expression and experience of emotions associated with self-preservation (e.g., escape-avoidance of aversive stimuli), the septal area mediates the experience of affects associated with sexual behavior (MacLean, 1986). Electrical stimulation of the septal area results in strong erotic feelings and increased libido. An important regulatory function performed by the septum is the inhibition of negatively motivated behaviors such as aggression. Self-stimulative electrodes implanted in the septum of human patients have been used to control impulsive aggression. In general, lesions of the septal area result in disinhibition of aggressive impulses together with exaggerated reactivity to startle—*septal rage syndrome*. Supporting this inhibitory function, the septum receives serotonergic projections from the raphe bodies in the brain stem. Apparently, the septal area performs an excitatory role over hedonically pleasurable affects (e.g., erotic sensations) while inhibiting aversive ones. Not surprisingly, it follows that septal damage adversely affects the animal's ability to play (Panksepp, 1998). Although cingulate lesions appear to negatively influence active avoidance learning (negative reinforcement), passive avoidance learning (positive and negative punishment) may be enhanced by such lesioning. In contrast, septal lesions interfere with passive avoidance learning (i.e., learning that requires strong inhibition) but do not appreciably interfere with active avoidance learning and, in some cases, may even improve it (Gray, 1971). Also, extinction and reversal learning in which a previously learned response must be abandoned or inhibited in order to learn a new one is disrupted by lesioning of the septal area.

Most investigations of subcortical and cortical limbic areas have been carried out with the aid of ablation techniques or electrical stimulation of target brain areas. This emphasis has naturally led some researchers to explore invasive procedures in the treatment of behavior disorders. Delgado (1969) has been particularly influential in this regard. In his famous demonstrations, a charging bull is halted in its tracks at the push of a button, showing in a very dramatic way that aggressive behavior can be controlled by remote electrical stimulation of the brain. His work offered hope that alternative treatment modalities for the control of intractable and otherwise untreatable behavior disorders might be on the horizon. Another area that has received some attention, including some rather horrifying applications in human patients, is neurosurgery. Although very little

experimental work utilizing neurosurgery as a means to control abnormal behavior has been carried out in dogs, it would appear from basic research that neurosurgery could provide relief in some cases involving severe or intractable anxiety, phobia, and aggression (Beaumont, 1983), especially where euthanasia is the only alternative. Prefrontal lobotomies have been performed on dog-aggressive sled dogs (malamutes) and on family dogs with various aggression problems (Allen et al., 1974). The surgeries appeared to be most effective in the management of intraspecific aggression in the sled dogs but yielded only limited benefits for pet dogs exhibiting aggression toward people. Other targets for such surgery that have been mentioned in the literature include thalamocingulate projections (cingulectomy), the thalamocortical pathways, or various sites in the amygdala and hypothalamus. Since a considerable amount of surgical risk and cost is associated with such interventions, the procedure is rarely used. A major problem associated with neurosurgery is the brain's tendency to compensate for its losses, often resulting in short-lived benefits (for weeks to months) from limbic lesioning (Thompson, 1967).

In addition to neurosurgery, electroconvulsive therapy (ECT) has also been used to treat aggression problems in dogs (Redding and Walker, 1976). The authors reported a significant reduction in aggression exhibited by the treated dogs toward the owner, children, dogs, or other adults (both men and women) as the result of ECT. Redding (1978) also suggests that ECT may prove to be a useful therapeutic tool in the treatment of other behavior problems, including fear biting, neurodermatitis, destructive tendencies, flank sucking, tail biting, and excessive fear of loud noises. The effect of ECT in the treatment of these behavior problems has not been evaluated. Redding (1978) recommends a treatment program involving daily multiple convulsive exposures (under general anesthesia) carried out over a week. After day 3 or 4, marked changes are usually observed in aggressive dogs in the direction of increasing docility. He notes that repeated treatments and retreatments may be necessary to maintain the improved behavior. As is the case in human patients, ECT has a pronounced effect on memory:

> After ECT treatment an "aura" of confusion and apparent loss of memory is observed in all patients. Owners report that their dogs are confused at times for 2 to 4 weeks after the treatment, after which there is a gradual return of memory. Following treatment and release from the hospital, the dog may show no more interest in the owner than in any other person. The ability to recognize the owner returns relatively rapidly, however. (1978:695–696)

According to Redding, memory loss is associated with the therapeutic benefit of ECT. To my knowledge, little additional research has been carried out to evaluate the effectiveness and side effects of ECT. Like psychosurgery, ECT has an ethical stigma attached to its use, making it a last-resort option for the treatment of refractory aggression—if used at all.

Learning and the Septohippocampal System

The largest subcortical limbic structure is the hippocampal formation. The hippocampus appears to be involved in the processing of memory and, in collaboration with other limbic structures, various affective and cognitive functions. Damage to the hippocampus results in an animal's inability to store recent memory but does not interfere with memories already consolidated before damage occurred. The hippocampus in conjunction with the septum appears to play an important role in response inhibition and habituation. It also serves important sensory processing functions. One sensory function it performs is the detection of novelty and familiarity. This attentional feature of the hippocampus may represent a significant factor in the hippocampal-lesioned animal's inability to form certain memories. Some theories suggest that an attentional/contextualizing interference may cause the hippocampus to "attend" inaccurately to significant stimuli.

The hippocampus together with other prominent structures belonging to the Papez circuit (hypothalamic mammillary body, the anterior thalamic nuclei, and the cingulate gyrus) appears to play important interactive

roles in the elaboration of emotional experience and expression (Steinmetz, 1994) (Fig. 3.3). According to the Papez circuit theory, emotional experience is generated when inputs from the hypothalamus are projected from the anterior thalamus into the cingulate cortex—the site where "environmental events are endowed with an emotional consciousness." Fibers from the cingulate cortex subsequently converge on the hippocampus, from where the loop is closed as the processed input is relayed back to the hypothalamus. Steinmetz summarizes the basic functions of this circuit:

> Each of these loops seems to serve a specific function that is associated with limbic system activity such as timing (septal loops), response processing (cingulate gyrus), processing of sensory stimuli (trisynaptic loop) and so on. The loop structure that is associated with the septo-hippocampal system provides sophisticated circuitry for information processing such as the processing that is necessary for generating emotional responses. Indeed, the neural processes that are involved in generating and regulating emotional responses require the integration of much information such as assessing the organism's internal and external environments, matching present experiences with past experiences, and selecting responses (both autonomic and somatic) that are appropriate for the situation. A relatively complicated circuitry, such as the limbic system with its variety of structures and interconnections, is likely at the heart of generating and regulating emotional states. (1994:24)

An important correlation appears to exist between the hippocampus and the septal area in their joint inhibitory functions. Under conditions of arousal and septal-hippocampal inhibitory control over ongoing behavior, the hippocampus exhibits a steady theta brain wave in contrast to surrounding desynchronized activity occurring elsewhere in the brain. Theta waves are produced in the hippocampus by novelty, pain, and frustration. Lesions of various brain sites (medial nucleus of the septum and certain nuclei of the thalamus), as well as the effects of various drugs (especially barbiturates), abolish or disrupt

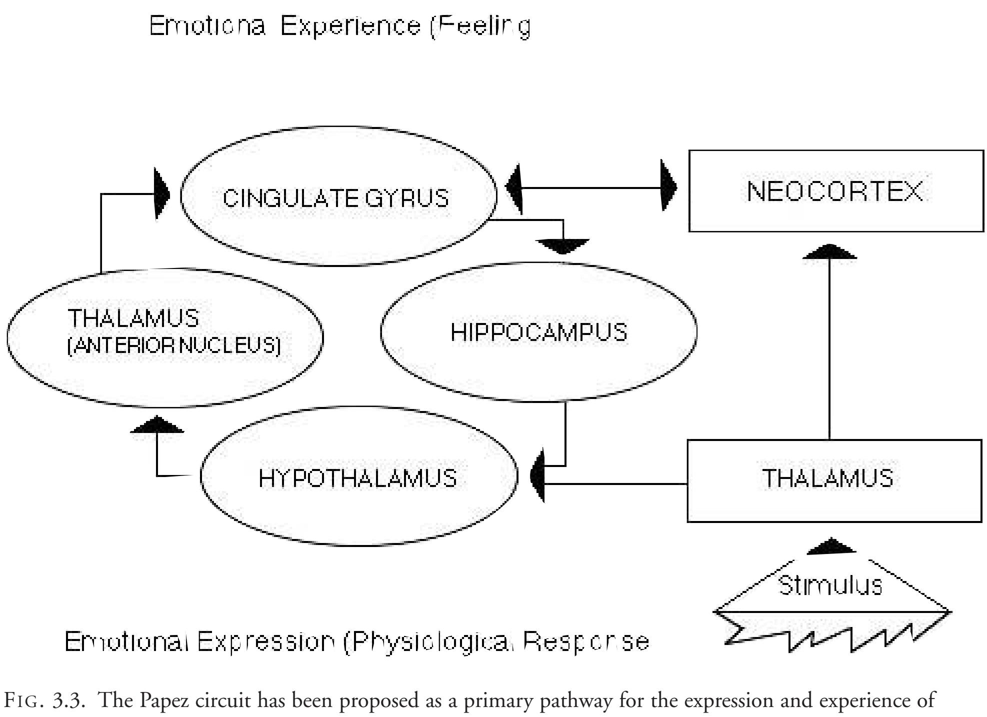

FIG. 3.3. The Papez circuit has been proposed as a primary pathway for the expression and experience of emotion.

these theta waves, which are believed to be associated with the normal inhibitory functioning of the septohippocampal system (SHS). Theta rhythms are generated by the hippocampus in an area called the dentate gyrus but are under the control of pacemaker cells in the medial septum (Gray, 1982).

In line with such a processing-modulatory function is Gray's speculation that the hippocampus, together with other limbic areas interacting with the SHS, serves to excite or inhibit behavior selectively (Gray, 1982). In conjunction with the ARAS, for example, the SHS appears to detect novelty in the environment and mediates the expression of surprise or startle. The SHS also mediates other forms of adaptation, including the most primitive form of stimulus learning—habituation. Orienting response studies performed by Sokolov and Vinogradova (reported in Gray, 1971) have shown that novelty and habituation are processed by a comparator mechanism located in the SHS. This mechanism compares ongoing stimulation with an animal's expectations of what should be occurring. If the results of this comparison between what is expected and what actually occurs are different, the effect produced is novelty (surprise/startle) and the evocation of an appropriate orienting response or intensified vigilance. If the stimulation is identical to what the animal expects, then habituation will occur—the dog gradually takes no notice of it. Habituation is highly specific, however. Sokolov's studies have shown that subtle changes of the stimulus complex (e.g., intensity, duration, quality, repetitive rate, and association with other stimulus events) may trigger a comparator "alarm" with a resultant recovery of the habituated orienting response. This subtle type of sensory sorting has led Gray to speculate that novelty reaches the SHS by a thalamocortical route rather than through the ARAS, which appears to be more dedicated to attentional functions arising from painful stimulation. An immediate outcome produced by novelty is the inhibition of ongoing behavior—a kind of "stop and think" hesitation occurs whenever a dog is faced with something significant and new. When the comparator finds a significant difference between what is expected and what actually happens, it signals and activates the behavior inhibition system (BIS). The BIS inputs cause ongoing behavior to stop. The BIS is particularly associated with punishment or frustrative nonreward. Both punishment and frustration disrupt ongoing behavior and subsequently invigorate or potentiate instrumental responding.

Another general system outlined by Gray involves the display of unconditioned escape behavior and affective aggression in response to fear- or anger-evoking stimuli. The flight-fight system (FFS) is predominately under the regulation and control of the hypothalamus and the amygdala. As previously discussed, the hypothalamus controls both affective aggressive displays and quiet predatory attacks.

Finally, Gray has postulated a behavioral activation system (BAS) operating in dopaminergic reward centers (nucleus accumbens) associated with the basal ganglia, neocortical structures, and various regulatory activities provided by the SHS, including important comparator functions. The BAS is associated with both the acquisition of reward and the termination or avoidance of punishment. The determination of whether a particular response is followed by reward or punishment depends on a comparator function. Voluntary behavior is self-reflective, requiring that at each moment the SHS evaluates the convergence or divergence of expected outcomes with what actually occurs. These various functions are coordinated by the prefrontal cortex, resulting in organized learning based on positive-feedback loops involving a series of predictions and confirmations that culminate in general expectancies about behavioral outcomes. Three basic outcomes on voluntary behavior are possible as the result of such expectancies: acquisition, extinction, or maintenance. Behavior that is followed by positive consequences exceeding expected outcomes is strongly reinforced, whereas behavior attended by consequences that are overpredicted (receiving a reward smaller than expected) results in a weakening of the associated behavior. Finally, responses followed by outcomes that are well predicted lead to confirmation of previously established expectancies but result in no new learning.

The BAS and positive learning evolved to

maximize direct contact with rewarding events and to avoid their loss or omission. In contrast, the BIS is concerned with the recognition of signals anticipating punishment, nonreward, or startle/novelty. In the presence of such signals, the BIS prompts an animal to inhibit ongoing behavior and to become more vigilant. The FFS involves affective displays aimed at removing fear-eliciting or threat signals by flight or attack. Gray (1991) postulated a theory of temperament that involves a combined contribution of these three systems. The BIS encodes relevant pathways and individual difference in the area of anxiety and impulsivity with heightened sensitivity to learning involving punishment; the FFS encodes traits predisposing an individual to various degrees of aggressive and defensive behavior, and the BAS is relevant to an animal's willingness to learn or alter behavior for positive reinforcement.

According to Rogeness (1994), conduct disorder in children may be conceptualized within the general framework of Gray's model. A child who is predominately controlled by reward mechanisms belonging to the BAS may be unable to adequately control maladaptive impulses that lead to immediate satisfaction. Such individuals are unable to inhibit consummatory behavior when faced with the immediate prospects of reward acquisition or escape-avoidance opportunities. Also, children with an underactive BIS may not condition well to signals predicting loss of reward or other forms of punishment. Since the BAS is mediated by dopaminergic activity and the BIS governed by noradrenergic activity, one would expect in an impulse-biased child or dog greater dopamine activity and tone, as well as reduced noradrenergic function. An additional factor, especially relevant with regard to the expression of aggressive behavior in such cases, is serotonergic projections from the dorsal raphe bodies terminating in the amygdala—an important area for the inhibition of aggressive behavior. Serotonin plays an important role in the regulation and inhibition of aggressive behavior—decreased serotonergic activity in these systems is associated with an increased likelihood of aggressive impulsivity under conditions of threat or frustration.

A dog governed by a strong BAS (strong dopaminergic activity) tends to be one that gets into perpetual trouble, moving from one "jam" to another. Such dogs are swept up by the moment's opportunities and governed by the acquisition of immediate gratification and the calculation of escape-avoidance strategies with which to avoid punishment—all rewarding events. BIS (strong noradrenergic activity)-controlled dogs, on the other hand, are more circumspect and responsive to punitive events impinging on them; such dogs are more likely to inhibit their behavior in the future following punishment instead of perpetually making the same mistakes. Theoretically, dogs governed by strong BAS activity and regulated by a weak BIS together with reduced serotonergic modulation over amygdaloidal interconnections are more likely to behave impulsively, possibly with episodic aggression. Perhaps, a diagnostic test differentiated by two biochemical parameters would be useful for the evaluation of certain forms of aggression: (1) evidence of decreased noradrenergic/serotonergic activity and (2) evidence of increased dopaminergic activity. Clinical investigations of drugs that inhibit the reuptake of NE and serotonin (e.g., amitriptyline and clomipramine) in conjunction with appropriately selective dopamine antagonists might prove very useful for the management of canine impulsive behavior disorders, including some forms of hyperactivity and aggression.

CEREBRAL CORTEX

The cortex, which is the outermost and latest development in the evolution of the vertebrate brain, is believed to be the central site of consciousness and intelligence, performing the most complex associative and mnemonic functions. The gray matter (the fissured and convoluted outer surface) is largely composed of neuron cell bodies stacked approximately 3 mm thick. Underlying the cortex is a white medullary structure composed of myelinated axonal fibers that communicate with different parts of the cortex and other proximal and distal areas of the brain. Beneath the medullary white matter are the basal ganglia, a collection of subcortical nuclei involved in

the mediation of complex movement, like walking and running. Removal of the cerebral cortex (but sparing the basal ganglia) results in the loss of sophisticated locomotor skills, but other motor activities, like running, walking, fighting, and sexual behavior, are not significantly affected. Besides motor functions, the cerebral cortex is intimately involved in the organization of somatosensory information and the elaboration of various cognitive functions, like learning and problem solving.

The cerebral cortex is divided into two large left and right hemispheres that are interconnected by the corpus callosum and other commissure fiber bundles, allowing the two sides of the brain to communicate with each other. An interesting feature of the cerebral cortex is that its two sides have a contralateral relationship with the body—for example, impulses originating on the right side of the cortex are responsible for motor activity on the left side of the body and vice versa. The cortex is functionally sectioned into several areas serving distinct roles: the frontal lobe (serving various unifying and associative functions), the temporal lobe or auditory cortex (responsible for receiving and processing auditory information), the precentral lobe or primary motor cortex (involved in fine motor activity), the parietal lobe (receiving somatic-tactual sensory input from the skin and body), and the occipital lobe (receiving and processing visual inputs).

The prefrontal cortex located in the frontal lobe receives input from many parts of the brain and assesses it in terms of a dog's changing needs, goals, and the current demands of the internal and external environment. In addition to the assessment of input, the prefrontal cortex decides on the course of action needed and directs the expression of programmed species-typical action patterns. The prefrontal cortex evaluates the effect of such behavior via reward-punishment outcomes (Suvorov et al., 1997). Consequently, pathways originating in the prefrontal cortex appear to play a very significant role in the coordination of goal-directed behavior, perhaps in conjunction with the behavioral activating system as previously described. Damage to the prefrontal cortex produces a number of significant cognitive and emotional dysfunctions. Allen and colleagues (1974) found that dogs that had undergone prefrontal lobotomy exhibited a high degree of distractibility, but, paradoxically, once they managed to focus on something, they seemed to hold their attention on it for an unusual length of time. Emotionally, the dogs with prefrontal damage (especially involving the orbitofrontal area) appeared disorganized and uninhibited. For example, the authors mention one dog that "growled while experiencing seemingly pleasurable stimuli" (1974:207).

The frontal cortex is a unifying association structure, serving many cognitive, memory, emotional, and motor functions. The prefrontal lobes appear to play a prominent role in learning, especially learning that requires a mental representation of the world. Animals suffering lesions to this area of the brain can learn simple conditioned associations and perform appropriate instrumental responses as long as the necessary information required to learn the behavior and perform it are present and held constant (e.g., a discrimination task involving a positive and a negative stimulus). However, animals with prefrontal lesions do poorly when required to perform a delayed-response task. For example, if a prefrontally damaged dog is shown the location of a piece of food and then briefly removed from the room, the dog would display a much retarded ability to remember where the item was last seen a few moments before. Mastering a delayed-response task requires that dogs form a mental picture or representation of the context and the location of the item in that context. Such effects of lesioning suggest that the frontal cortex plays an important role (in conjunction with limbic structures like the hippocampus and amygdala) in the operation of working memory (Goldman-Rakic, 1992).

The temporal cortex, which is located laterally on the cortex toward the front, is primarily concerned with the organization of information derived from audition. Cortical functions originating in the temporal lobes also appear to play an important role in the formation of complex visual patterns. A dog's ability to recognize its owner's face from others probably involves the participation of the

temporal lobe. This area is the only cortical structure to receive projections from all the sensory modalities. The temporal lobes play an important role in the higher elaboration and the conscious experience of emotion, receiving projections from the limbic system and more primitive input directly from the thalamus. Monkeys that have undergone extensive damage to the temporal lobes do not exhibit normal fears and anxieties, are unusually calm and placid while being handled, and tend to engage in compulsive oral behavior. For instance, unlike normal monkeys, lesioned animals may pick up snakes and lighted matches without exhibiting any apparent fear. These effects of temporal lobe lesioning and damage to underlying limbic structures located in the temporal lobes are collectively referred to as the Kluver-Bucy syndrome (Kluver and Bucy, 1937). The authors refer to these phenomena as examples of "psychic blindness," arguing that the absence of fear could not be fully explained by reduced emotional reactivity alone, suggesting that the lesioned animals may simply fail to "recognize" the items as innately feared objects.

Considering the important associative and regulatory functions that are performed by the frontal cortex, it would seem reasonable to conclude that the frontal cortex (especially localized in the prefrontal and orbitofrontal areas) probably plays a considerable role in the control of impulsive and episodic behavior, such as aggression and panic. In addition to exercising regulatory control over target subcortical trigger sites (e.g., the amygdala and hypothalamus) and motor programs in the basal ganglia, it is a central area for interpreting and integrating the hedonic arousal resulting from highly motivated behavior, thereby providing a means to enhance central control over such impulses through learning. Unfortunately, as noted by LeDoux (1996), the connections from the amygdala to the cortex are far stronger than the regulatory connections from the cortex to the amygdala—a functional asymmetry that may help explain the failure of some animals to gain full control over their fearful or aggressive impulses (Fig. 3.4). Also, some evidence suggests that the prefrontal cortex is affected by the dimorphizing influence of perinatal hormones (Kelly, 1991), perhaps affecting cortical regulatory control over fear and aggression, as well as influencing many other neural activities. This possibility is consistent with the general observation of trainers and behaviorists that male dogs present more frequently with aggression and other common behavior problems than female dogs. Although various mechanisms and neural sites are probably influenced by such hormonal activity, the prefrontal area may be particularly important because of the influence that it appears to exert on the perception of social signals and the

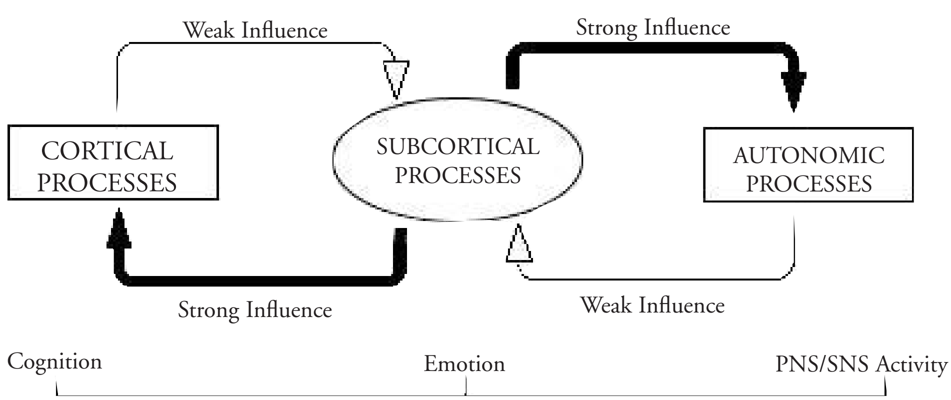

FIG. 3.4. Diagram of the asymmetrical interactions between cortical, subcortical, and autonomic neural processes. PNS, parasympathetic nervous system; SNS, sympathetic nervous system.

coordinated actions that it directs in response to that information. Brain and Haug describe the close relation between hormones and social communication:

> Hormones can be regarded as acting on situational factors by altering the perception of signalling between conspecifics. Evidence for hormonal involvement in perception has been obtained for all the major sensory systems. ... Hormones also may alter the probability of the production of signals that serve social functions. The most frequently modified signals are somatosensory, olfactory, visual, and auditory. For example, androgens and estrogens have major effects on olfactory social communications in both rodents and infra-human primates. (1992:543–544)

The parietal lobes, which are located on either side of the cortex toward the rear, make up a central cortical region mainly involved with processing somatosensory information from the body. This area is concerned with the senses of touch (pressure), warmth, cold, and pain. It is also responsive to proprioceptive sensory input from the muscles, tendons, and joints. The parietal area contains several mental representations of the body mapped out over its surface that correspond to various parts of the body. Depending on the amount of sensory input and the particular sensory modality's importance to the species involved, the size of any particular area represented in the cortex will vary. Rats (which depend on their whiskers to a great extent) have a disproportionately large area of their somatosensory cortex devoted to the mapping and representation of sensory input from their whiskers. Eichelman (1992) has noted that the mere clipping of a rat's whiskers has an equivalent suppressive effect on affective aggression as a bilateral amygdalectomy. The amount of the cortex mapped for any sensory modality is proportionately correlated with the relative size of the thalamic relay involved (Thompson, 1993). The occipital lobe is located at the rear of the brain and is primarily involved in the processing of visual information relayed to it by the thalamus. Extensive lesioning of the occipital lobe of the cerebral cortex results in blindness.

Even though a dog's behavior is strongly influenced by intrinsic neurobiological processes, it remains flexible and responsive to the adaptive influence of learning. An important function of behavioral intervention is to improve a dog's ability to focus attention, to exercise impulse control, and to develop a more adaptive repertoire of coping strategies. Most veterinary clinicians emphasize the importance of adjunctive behavior modification when administering psychotropic medications, such as fluoxetine. While the subcortical circuits mediating the expression of affective aggression can be modulated by such drugs, treatment is only lastingly effective if corresponding cortical regulatory control is enhanced at the same time through learning. In severe cases, medications may help dogs to obtain better self-control over their dysfunctional or problematic impulses, but such drugs can never take the place of sound training and behavioral intervention.

Neurotransmitters and Behavior

An important cellular function performed by neurons is the manufacture of chemical neurotransmitters. Neurotransmitters are produced in the cell body of specialized neurons by the endoplasmic reticulum, which is dispersed throughout most of the cytoplasm of the neuron. After manufacture, neurotransmitters are stored in vesicles produced by another cell structure called the Golgi apparatus. The vesicles containing the neurotransmitter are subsequently transported down the axon along microtubules and stored in the presynaptic terminal. This process is called axonal transport and includes both a slow and fast variety. Fast transport moves chemical transmitters quickly down the axon at a rate of 10 to 20 mm a day, whereas slow transport may move substances at a much slower rate of only about 1 mm per day. Axon transport takes place in both directions—both away from and back toward the cell body (Thompson, 1993).

Acetylcholine

As previously discussed, communication between neurons takes place at small gaps between neurons called synapses. Different

chemical transmitters are involved, each possessing specific functions at different levels of neural organization. Peripheral neurons innervating skeletal muscle fibers act via the release of acetylcholine (ACh). The secretion of ACh into the synaptic cleft stimulates adjacent postsynaptic receptor sites to open ionic channels, resulting in the depolarization of the affected cell. The stimulative effects of ACh continue as long as it remains in the synapse. To open the synapse for additional transmissions, the receptor cell releases acetylcholinesterase (AChE), an enzyme that degrades ACh into acetate and choline. An interesting aspect of ACh in the body is that it exhibits an excitatory or an inhibitory effect depending on the muscle receptors involved. Skeletal muscles are excited by ACh, whereas the heart muscle is inhibited by it. Curare, a compound used experimentally to inhibit voluntary muscle activity, blocks the receptor sites for ACh in the skeletal muscles (resulting in paralysis) but has no effect on the heart muscle. Atropine, on the other hand, blocks the inhibitory effects of ACh on the heart muscle but has no discernible effect on skeletal muscles. Nicotine acts on skeletal muscle receptor cells in much the same ways as ACh. Sites sensitive to the excitatory effects of nicotine and ACh are referred to as *nicotinic* receptors. Muscarine (a poison derived from mushrooms) has an inhibitory effect much like that of ACh on the activity of the heart. As a result, ACh receptor sites that serve to slow the heart rate are called *muscarinic* receptors.

Glutamate and GABA

Synaptic transmission within the brain is also mediated by neurotransmitters synthesized from various amino acids derived from dietary protein. Excitatory transmissions are conducted by glutamate, whereas GABA is responsible for inhibitory transmission across neural synapses. Unlike ACh, glutamate and GABA are not broken down by enzymatic actions within the synaptic cleft but are reabsorbed by the presynaptic terminal through a reuptake process called pinocytosis. During the reuptake process, the presynaptic membrane enfolds around the transmitter molecule, drawing it back into the axon. Glutamate and GABA balance and check each other through a complex excitatory-inhibitory process of neural homeostasis. A complete loss of GABA in the brain would result in uncontrolled excitation and convulsions.

GABA has been implicated in the control of phobias and generalized anxiety disorders. Intense fear and anxiety problems in dogs are frequently treated with various benzodiazepine preparations. Such anxiolytics appear to affect benzodiazepine-GABA receptors concentrated along fear circuits communicating between the amygdala and hypothalamus. Benzodiazepine receptors are closely associated with GABA receptors. Medications such as diazepam (Valium) appear to work by modifying the binding of GABA to its receptor, thereby amplifying receptor activity and reducing fear and anxiety by inhibiting activity in fear circuits (Panksepp, 1998). Murphree (1974) tested the effects of several common psychotropic drugs on the extreme anxiety reactions of genetically fearful pointers. Of the various drugs tested, which included phenobarbital, chlorpromazine, amphetamine, and alcohol, Murphree determined that the benzodiazepines were "far superior." Nervous dogs treated with benzodiazepines learned a bar-pressing response more quickly and performed the response at a higher rate than dogs not treated. Since benzodiazepines have specific receptor sites mediating their effect on fear and anxiety, it has been speculated that the brain itself produces anxiolytic substances much like the analgesic opioids (endorphins) are produced in response to pain. Like morphine, benzodiazepines are potentially highly addictive.

Catecholamines: Dopamine and Norepinephrine

Another group of important neural transmitters are the catecholamines. Tyrosine (an amino acid) is converted through various chemical actions from L-dopa (L-3,4-dihydroxyphenylalanine) to dopamine, NE, and lastly epinephrine. Each of these chemical changes requires the action of a specific enzyme. Some neurons possess the necessary

enzymes needed to produce dopamine, whereas others have an additional enzyme for the synthesis of NE (Fig. 3.5). Although epinephrine is not produced in the brain, its production is under hypothalamic influence via the adrenal medulla.

Most dopamine is produced and distributed through three brain systems: (1) The nigrostriatal system involves dopamine-producing neurons originating in the substantia nigra of the midbrain, with axons projecting into the basal ganglia (a forebrain area involved in coordinated movement). (2) The mesolimbic system originates in dopamine-producing cells within the ventral tegmental area (located adjacent to the substantia nigra). Mesolimbic axons project to various regions via the MFB, including the amygdala, lateral septum, hypothalamus, hippocampus, and nucleus accumbens. (3) The mesocortical system also originates in the medial tegmental area, with axons projecting to the limbic cortex (cingulate and entorhinal areas), prefrontal cortex, and hippocampus. In addition, a fourth dopamine system communicates between the hypothalamus and the pituitary gland. Both mesolimbic and mesocortical dopamine circuits have been implicated in the development of serious cognitive and behavioral disorders, such as schizophrenia (Kandel, 1991). It has been theorized that an affected person's brain contains either too much dopamine or too many receptor sites for dopamine activity. Phenothiazines are a class of major tranquilizers that bind with these receptor sites, thereby preventing dopamine from doing so. Chlorpromazine (Thorazine) is a commonly prescribed antipsychotic drug that functions specifically as a dopamine antagonist. On the other hand, depletion of dopamine can also result in serious problems, as observed in Parkinson's disease, which involves the second dopamine circuit (nigrostriatal) originating in the substantia nigra, with projections terminating in the basal ganglia. Parkinson's disease results from the depletion of dopamine and the destruction of dopamine-producing neurons. The disease is associated with several motor deficiencies, including repetitive movement, tremors, and loss of coordinated movement. Parkinson's disease is treated with the dopamine precursor L-dopa. Dopaminergic circuits have been implicated in the development of compulsive disorders in dogs. Finally, dopamine plays a central role in the mediation of classical and instrumental learning. Reward experiences occurring as the result of either negative or positive reinforcement appear to be dopamine dependent. The reinforcement effects derived from appetitive stimuli, as well as those occurring as the result of the successful avoidance of aversive stimulation, are both interfered with when dopamine activity is blocked (Carlson, 1994).

NE circuits in the brain originate in neurons belonging to the locus coeruleus located in the brain stem. Axonal fibers extending from these NE-producing neurons project into all major structures of the brain. These

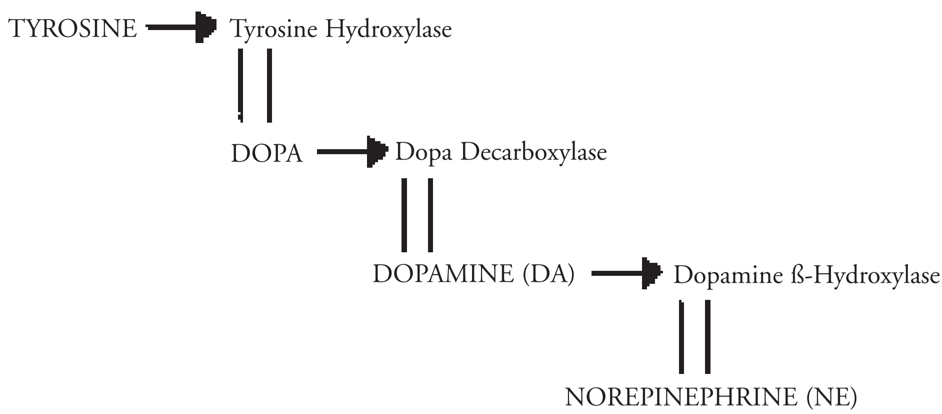

FIG. 3.5. Synthesis of catecholamines from dietary tyrosine.

diffuse projections contribute to the ARAS, providing a steady level of arousal or wakefulness within these divergent circuits and systems. NE axons often form synaptic terminals in a very different way than the basic pattern previously described. Instead of the conventional synapse, the NE axons form swollen protuberances along their surfaces. At each of these protuberances, NE is released as the action potential moving along the axon reaches these swellings. NE is reabsorbed through a reuptake mechanism. Among its many functions, NE is an excitatory transmitter of the ANS, stimulating increased heart rate and respiration during sympathetic arousal.

Serotonin (5-Hydroxytryptamine)

An important neurotransmitter in the neural economy of dogs is serotonin or 5-hydroxytryptamine (5-HT), which is especially important for the control of sleep cycles and has been implicated in the neurochemistry of stress, depression, and aggression. Specialized neurons manufacture serotonin from nutritional tryptophan (Fig. 3.6). Serotonin is stored in vesicles located in the presynaptic axon, and under appropriate stimulation, these serotonin-containing vesicles are released into the synaptic cleft. Serotonin molecules bind to specific serotonergic-receptor sites located on the postsynaptic neuron. Like other monoamines already discussed, serotonin is not broken down in the synapse like ACh but is recaptured through a reuptake mechanism. Excess amounts of serotonin are broken down by monoamine oxidase (MAO) within the presynaptic terminal. Serotonin-producing neurons are located in the raphe nuclei located in the medulla, with projections into various parts of the brain. The raphe nuclei send serotonin-containing fibers to sleep-wake regulatory centers in the hypothalamus (suprachiasmatic nucleus), to the amygdala, hippocampus, septum, basal ganglia, and cerebral cortex. Besides controlling sleep-wake cycles, serotonin projections terminating in the limbic system play an important role in inhibiting anger and aggression. Further, serotonin directly attenuates the subjective experience of pain occurring during highly emotional displays involving anger or aggression, thereby mitigating against the effectiveness of physical punishment in the control of emotionally charged (affective) aggression.

Depression is often treated with drugs that either inhibit the reuptake of serotonin and NE or block the action of MAO—an enzyme that chemically breaks down the neurotransmitter. MAO inhibitors prevent the enzymatic breakdown of serotonin and other monoamines reabsorbed into the presynaptic terminal, thus making more of these substances available for use. Antidepressants like fluoxetine (Prozac) function to keep more serotonin in the synaptic cleft by selectively inhibiting its reuptake. Other antidepressants (tricyclics) like imipramine (Tofranil) and amitriptyline (Elavil) inhibit the reuptake of both serotonin and NE. The benefits of tricyclic medications on depression have led to theories implicating low levels of serotonin and NE in its development. Iorio and colleagues (1983) isolated a group of "depressed" beagles and tested various anxiolytic and psychotropic drugs on them. That re-

TRYPTOPHAN ⟶ Tryptophan Hydroxylase
‖
5–HYDROXYTRYPTOPHAN (5–HTP) ⟶ 5–HTP Decarboxylase
‖
SEROTONIN (5–Hydroxytryptamine, 5–HT)

FIG. 3.6. Synthesis of serotonin from dietary tryptophan.

search group found a significant improvement in 50% of the dogs exposed to imipramine, amitriptyline, and isocarboxazid (an MAO inhibitor). Interestingly, the dogs tested all exhibited a 2-week (10- to 17-day) delay from the onset of treatment to the appearance of signs of improvement. None of the dogs showed immediate improvement under tricyclic treatment, and all (except one) returned to baseline levels of depression when medication was withdrawn after 28 days.

More recently, Rapoport and colleagues (1992) demonstrated a connection between serotonergic activity and acral lick dermatitis (ALD), a compulsive disorder in dogs. A total of 42 dogs exhibiting compulsive licking were exposed to controlled trials involving various drugs, including clomipramine (Anafranil) and fluoxetine (Prozac). The results of the study showed that clomipramine (a tricyclic antidepressant) and fluoxetine [a selective serotonin reuptake inhibitor (SSRI)] were both effective against ALD, whereas the other medications tested were not beneficial. The authors speculate from research carried out by Jacobs and coworkers (1990) in cats that a specific serotonin subsystem in the dorsal raphe may be inappropriately activated by chewing and licking, thus implicating it as a potential neural site for ALD.

Clomipramine has also been shown to be an effective medication for the treatment of fear and generalized anxiety in companion dogs not responsive to behavior therapy (desensitization and counterconditioning) or previous treatment with anxiolytics (diazepam) or other tricyclics lacking strong serotonin reuptake-blocking effects (Stein et al., 1994). The study involved five dogs of various ages and breeds presenting with symptoms of fear and generalized anxiety. All the dogs exhibited improvement (three of them much improved to very much improved) within 2 to 3 weeks under the influence of clomipramine. A previous study carried out by Tancer and colleagues (1990) evaluated the effects of imipramine (Tofranil, a related tricyclic drug) on 17 genetically nervous pointers but without much success. Imipramine is commonly prescribed for the control of panic disorder in humans. In the case of the nervous pointers, however, little sustained improvement was observed in the dogs treated orally with 50 mg given twice daily.

Monoamines and the Control of Aggression

Several studies have implicated monoamines in the regulation of aggressive behavior (Siegel and Edinger, 1981). For example, quiet or predatory aggression is significantly reduced in animals by increasing the levels of NE in the hypothalamus and the medial nucleus of the amygdala. On the other hand, increased levels of NE stimulate affective hostility involving intruder-induced or pain-induced aggression. Eichelman and colleagues (1981) have reviewed the relevant literature regarding the biochemistry and pharmacology of aggression. Included was a series of studies by Reis (1972) demonstrating that electrically induced rage via the amygdala in cats results in the depletion of NE reserves in both forebrain and brain stem areas. Other studies of decerebrate cats have shown that electrical evocation of sham aggression results in a depletion of NE in the brain stem in proportion to the magnitude and duration of the rage evoked. This depletion is followed by a sharp increase of NE metabolism as evidenced by rising levels of tyrosine hydroxylase activity (Leventhal and Brodie, 1981). Tyrosine hydroxylase is the *rate-limiting factor* in the production of both dopamine and NE. The amount of this enzyme in the neuron determines how much NE it can produce. Sham rage is entirely suppressed in cases where catecholamine reserves are completely depleted and synthesis is chemically blocked. Lithium, a drug that reduces brain NE, attenuates shock-induced aggression, but this effect is confounded by a possible involvement of increased serotonin availability also caused by lithium.

Arons and Shoemaker (1992) studied the distribution of catecholamines (dopamine and NE) and beta-endorphin in different brain regions of three behaviorally distinct breeds: the Border collie, shar planinetz, and the Siberian husky. These breeds exhibit different predatory responses toward mice serving as prey, with the husky showing the most

predatory and consummatory behavior and the shar showing the least predatory and consummatory behavior toward mice. They found significant differences in the relative concentrations of some of the neural transmitters measured, suggesting that breed-specific behavioral differences may be related to underlying neurochemical differences obtained through selective breeding. For example, in the lateral hypothalamus, a site associated with quiet attack, shars exhibited a significantly lower concentration of dopamine than found in collies or huskies. Despite the evident breed differences in catecholamine concentrations, the authors note that complex behavior patterns like predation are probably governed by a complex interaction of many neurotransmitter systems. One particular neurotransmitter differentiation between the breeds studied seemed especially suggestive. An important trait difference between collies, shars, and huskies is their general activity and exploratory levels. Collies and huskies tend to be more active and interactive with their immediate environment than are shars. NE is frequently associated with arousal and general activity levels. Consequently, it is not surprising to find that collies and huskies exhibit a 40% to 60% higher level of NE than shars in important NE areas of the brain (e.g., the locus coeruleus, brain stem, and diencephalic areas). NE levels may provide an important biological marker correlated with general activity and exploratory levels in different breeds of dogs.

Although cholinergic pathways in the brain are not as well studied as monoaminergic pathways, some studies have shown a linkage between ACh and aggressive behavior. Injections of ACh placed in the ventricular system (fluid-filled areas inside the brain) result in affective aggression and rage in cats. Further, direct cholinomimetic stimulation (carbachol) of the amygdala also results in aggressive behavior in cats. Cholinergic agonists injected into the lateral hypothalamus of nonkilling animals induces quiet attack behavior. This predatory response is blocked by the cholinergic antagonist atropine (Eichelman, 1987). Dopaminergic and beta-adrenergic blockers do not suppress cholinergic-induced aggression (Leventhal and Brodie, 1981).

Increasing evidence suggests that the indoleamine serotonin plays an inhibitory role over the exhibition of both predatory (quiet attack behavior) and affective aggression. Depletion of serotonin increases affective aggression in rats and quiet attack behavior in cats, whereas increased serotonin production reduces affective aggression in rats and reduces fighting behavior among isolated (usually more aggressive) mice. Recently, Reisner and colleagues (1996) demonstrated that the cerebrospinal fluid (CSF) of dogs exhibiting dominance-related aggression contains lower levels of serotonergic and dopaminergic metabolites than found in normal (nonaggressive) controls. Among the dominant-aggressive dogs studied, those that reportedly attacked without warning were found to have significantly lower concentrations of 5-hydroxyindoleacetic acid (5-HIAA) and homovanillic acid (HVA) in their CSF than those dogs that gave warning before biting. The investigators suggest that this difference between dogs that warn and those that do not may indicate an impairment of a serotonergic-mediated impulse control mechanism modulating such aggressive displays. Also, dogs studied that had a history of biting hard (puncturing or lacerating the skin) tended to have lower concentrations of 5-HIAA and HVA than did dogs not delivering damaging bites. Interestingly, Popova and colleagues (1991) found significant differences in the serotonergic activity of human friendly versus human aggressive/defensive silver foxes. Foxes selected for tame behavior have greater amounts of serotonin and related by-products in their brain tissue, suggesting increased serotonergic activity. Popova and coworkers speculated that increased serotonergic activity may play an instrumental role in the process of domestication, serving to reduce aggressive tendencies and replacing them with more prosocial and tame ones. They found a similar pattern of increased serotonergic activity in tame versus wild Norway rats.

The influence of serotonin on aggressive behavior appears to be linked to the strong inhibitory effect that the neurotransmitter has over emotional processes and impulsive behavior. Stein and coworkers reported find-

ings indicating that a decrease in serotonergic activity results in "an inability to adopt passive or waiting attitudes, or to accept situations that necessitate or create strong inhibitory tendencies" (1993:10). Reducing the availability of serotonin by blocking its synthesis or available receptor sites negatively affects the suppressive effects of punishment, whereas the restoration of normal serotonin levels reverses this disinhibitory effect. Olivier and colleagues (1987) demonstrated strong inhibitory effects of serotonin-enhancing drugs on the frequency of various forms of aggression exhibited by mice and rats, including intermale aggression (mice), resident-intruder aggression (rats), isolation-induced aggression (mice), maternal aggression (rats), and mouse-killing behavior in rats. Especially strong inhibitory effects were observed in animals medicated with the serenics fluprazine and eltoprazine (serotonin agonists). Eltoprazine, in particular, exhibited very promising characteristics for the control of aggressive behavior. It not only inhibited a wide spectrum of aggressive behaviors, but seemed initially to be highly specific with few collateral side effects on other behavioral systems. Unfortunately, subsequent research seems to indicate that the aggression-reducing effects may be due to anxiogenic side effects. Dodman (1998) found that although eltoprazine did reduce aggression, it also appeared to elevate anxious behavior in the two dogs treated. Other research (Kemble et al., 1991) seems to support the conclusion that serenics elevate social anxiety, thus making their use highly questionable in the control of aggressive behavior.

The apparent connection between enhanced serotonin activity and the inhibition of aggressive behavior has led to the widespread use of SSRIs and tricyclic antidepressant medications for the control of canine aggression problems, especially dominance-related aggression (Dodman et al., 1996a). Another drug found to show some promise for the control of dominance aggression in dogs is lithium (Reisner, 1994). Physiologically, lithium decreases NE turnover and inhibits tyrosine hydroxylase activity, thus affecting dopamine production. In addition, lithium produces an increase in blood levels of tryptophan; increases serotonin production in the brain, while at the same time inhibiting its metabolism; and, in general, enhances the aggression-inhibiting functions of the serotonergic system (Leventhal and Brodie, 1981).

Diet and Enhancement of Serotonin Production

The brain's production of serotonin depends on nutritionally derived tryptophan. Tryptophan, like other precursor amino acids used in the manufacture of neurotransmitters, reaches the brain by passing through the blood-brain barrier. Research first carried out at the Massachusetts Institute of Technology under R. J. Wurtman has demonstrated that diets rich in protein tend to deplete brain tryptophan levels. This is a somewhat paradoxical finding, since tryptophan is a protein-forming amino acid and should be made more available to the brain as blood protein levels increase (Young, 1986). Even more paradoxical is a related finding that diets high in carbohydrates actually increase available tryptophan for serotonin synthesis, even if the food itself contains only modest amounts of tryptophan. The explanation for these apparent discrepancies involves two parts. (1) Naturally occurring tryptophan represents only a small proportion of the various amino acids making up protein (approximately 1% to 1.6%). The other larger and more prevalent amino acids all compete with tryptophan for a limited number of transport channels passing through the blood-brain barrier. The result of the foregoing biochemical scenario is that tryptophan is blocked out and the brain may be quickly depleted of available stores of the amino acid needed for the steady production of serotonin. (2) A more complicated metabolic process is needed to explain how a high-carbohydrate diet raises brain levels of tryptophan. Diets containing a proportionately higher level of carbohydrates than protein (at least 1 part protein to 5 to 6 parts carbohydrate) stimulates the secretion of insulin. An important effect of insulin production is its diversion of large neutral amino acids (other than tryptophan) into muscle tissue. Because of its unique molecular structure

differentiating it from other amino acids, tryptophan is not similarly affected by the secretion of insulin. The outcome is that the proportion of plasma tryptophan is greatly increased, thus obtaining an advantage over other amino acids competing for transport through the blood-brain brain. As a result, the brain's production of serotonin is significantly increased.

For the increased movement of tryptophan to occur, the diet must be kept both low in protein and high in carbohydrates. In rats, a diet with protein levels exceeding 18% is sufficient to block the tryptophan effect (Spring, 1986). The exact percentages for dogs have not been determined but are assumed to be very similar (Dodman et al., 1996b). Unfortunately, these estimates have not been confirmed through appropriate physiological studies.

A common protein source in dog foods is corn. Corn, however, is unusually low in tryptophan and may represent some risk to animals sensitive to serotonergic underactivity. Lytle and colleagues (1975), who studied the effects of a restricted corn diet on pain thresholds in rats, found that a diet restricted to corn as the primary source of protein results in a significant reduction of plasma and brain levels of tryptophan, with a subsequent decrease in the production of brain serotonin. Serotonin has an important analgesic effect on pain. Animals fed a restricted corn diet exhibit a lower threshold for pain (measured by the magnitude of a flinch or jump response to electric shock) than controls on a balanced amino acid diet of casein. Test subjects fed a tryptophan-rich diet or receiving an injection of tryptophan soon recovered from the hyperalgesic effect induced by the corn diet.

The foregoing studies are suggestive for the management of pain and aggressive behavior in dogs. Ballarini (1990) proposed that dietary protein be routinely adjusted as part of a comprehensive treatment program involving aggression in dogs. A study carried out by Dodman and coworkers (1996b) showed a promising linkage between reduced dietary protein and some forms of aggressive behavior in dogs. Dogs exhibiting territorial aggression with a strong component of fearfulness responded beneficially to a reduced protein diet (17%), while territorial aggressors of the dominant type showed no significant change. The study, however, is not without possible flaws, perhaps accounting for its failure to show a stronger response than reported. Three problematic areas stand out: (1) protein levels were not kept sufficiently low, (2) carbohydrate levels may not have been high enough to induce an increased passage of tryptophan across the blood-brain barrier, or (3) the dogs may not have been exposed to the diet for a sufficient time. Behavioral effects from the diet were measured only after a relatively short period (2 weeks), so perhaps added benefits might be expected from a longer-term exposure (6 to 8 weeks). Also, Aronson has noted that, in addition to the diet's beneficial effect on fear-related territorial aggression, it is "possible that a more radical reduction in dietary protein levels would produce a reduction of dominance aggression and hyperactivity as well" (1998:80).

An important area of basic research is obviously wanting: a determination of the relative protein/carbohydrate proportions and percentages needed to induce (or block) tryptophan influx in dogs. Before any conclusions can be drawn with regard to the effect of low-protein diets on impulsive agonistic behavior in dogs, such questions will need to be explored and answered in detail. Furthermore, no study to date has directly implicated dietary tryptophan depletion in the causation of canine aggression or hyperactivity, except by way of extrapolation from studies involving other animal species. Therefore, another important area of future research is determination of the effect of tryptophan depletion and supplementation on canine behavior. In a prototype study conducted by Chamberlain and colleagues (1987) in vervet monkeys, the monkeys were fed an identical diet except for the relative content of nutritional tryptophan. Three groups of monkeys were differentially fed diets containing normal tryptophan levels, high tryptophan levels, and low tryptophan levels. Although little benefit was seen with the provision of a

higher percentage of tryptophan in the diet, a strong correlation was observed in terms of two parameters of aggression and the low-tryptophan diet. Monkeys fed a relatively low-tryptophan diet exhibited an increase of competitive aggression over food (dominance aggression) and spontaneous agonistic displays among themselves. The researchers also found a significant link between tryptophan depletion and an increase in general motor activity. Interestingly, in both cases, the observed behavioral effects of tryptophan depletion were restricted to male monkeys.

The level of tryptophan in the blood serum of assaultive alcoholics is at a lower than normal ratio to other amino acids, suggesting a possible connection between serotonin depletion in the brain and the exhibition of impulsive aggression among alcoholics. Morand and colleagues (1983) performed a pilot study with human patients to determine the effects of tryptophan on chronically aggressive schizophrenics. The study involved supplemental tryptophan at dosages of 4 to 8 grams a day. There was an approximately 30% reduction in the incidence of aggressive behavior while the patients received the tryptophan supplementation, but the response of patients was variable, with some becoming even more depressed and disorganized. Christensen (1996) wrote a critical review of the literature on the relationship between diet and behavior, providing a concise and objective summary of the current state of research in this important area.

Arginine Vasopressin and Aggression

Vasopressin has received considerable experimental attention, especially with respect to its influence over scent marking, dominance behavior, and affective aggression. Also known as antidiuretic hormone, vasopressin is a peptide hormone that controls water retention by the kidneys. In addition to this peripheral role, the hormone also appears to play a central neuromodulatory function over the expression of aggressive behavior. C. F. Ferris (University of Massachusetts Medical School), who has studied the effects of arginine vasopressin (AVP) in golden hamsters for several years, found that the vasopressinergic system in the hypothalamus mediates the expression of several agonistic behavior patterns: flank marking (an AVP-dependent behavior), offensive aggression, and the formation of dominant-subordinate relationships (Ferris et al., 1986; Ferris and Potegal, 1988).

AVP receptors overlay androgen and estrogen receptors, suggesting that sex hormones and AVP may interact in the expression of aggressive behavior. In fact, the aggression-facilitating effect of AVP appears to *depend* on the presence of testosterone. Delville and coworkers (1996), for example, found that the hamster's behavioral response to microinjections of AVP varies depending on the presence or absence of testosterone. They showed that latency of attack is reduced by AVP microinjections into the ventrolateral hypothalamus (VLH), but only if the subjects are pretreated with testosterone prior to injection. Although AVP regulates the onset and latency of aggression via the VLH, it does so without concurrently affecting the behavior's strength or number of bites delivered—a dimension of attack behavior that appears to be controlled by the selective activation of AVP receptors in the anterior hypothalamus (AH). This work suggests that the VLH and AH play different functional roles in the expression of aggressive behavior.

The regulation of aggressive behavior is more complicated than the interactions of testosterone and AVP acting directly on the hypothalamic vasopressinergic system. Besides AVP and sex hormones, researchers have discovered a robust interaction between AVP and serotonin in the hypothalamus (Ferris and Delville, 1994). Both the ventrolateral hypothalamus and anterior hypothalamus exhibit a high concentration of serotonin-bearing axon terminals and binding sites. Interestingly, fluoxetine (Prozac) injected peripherally inhibits AVP-induced offensive aggression and retards the onset of resident-intruder attacks, with fewer bites occurring during the attacks (Ferris and Delville, 1994; Ferris et al., 1997). These studies suggest that

serotonin directly modulates AVP neurons in the hypothalamus, thereby antagonizing AVP-system-facilitated aggression.

There are many potential implications of this work for dogs. Until recently, progestins were commonly used for the control of unwanted aggression and marking behavior. The most frequently mentioned target site of progestin action is the hypothalamus, perhaps including the targeting and disruption of AVP activity. An antivasopressinergic link would appear logical, since progestins produce a diminution of both urine marking and aggressive behavior in treated animals. More recently, the veterinary use of fluoxetine has become increasingly popular for the control of unwanted behavior, especially dominance-related aggression and various compulsive disorders. Fluoxetine is rarely prescribed for intraspecific or territory-related aggression; given the findings of Ferris, though, perhaps such a wider use might prove very beneficial, especially in cases of refractory dog fighting and territory-related aggression. Lastly, serotonin-enhancing drugs may play a beneficial role in the control of household urine marking by dogs.

Neural Substrates of Motivation (Hypothalamus)

Beginning with the pioneering work of Olds and Milner (1954), many studies have shown that direct stimulation of various parts of the brain produces pleasurable feelings. Although electrical stimulation of the anterior hypothalamus evokes intense sexual excitement, lesioning of the same site results in a loss of sexual drive and interest. In addition to the evocation of highly motivated and directed behavior, such intracranial stimulation of the anterior and lateral hypothalamus (especially the MFB) results in a pronounced experience of general pleasure and activation. Both areas of the hypothalamus function as brain reward sites. An interesting feature of hypothalamically stimulated pleasure is that it is not associated with actual consummatory satisfaction but instead results in the augmentation of appetitive need or desire for the reward object. Consequently, the pleasure areas of the hypothalamus appear to be more connected with drive induction than drive reduction. Stimulation of sites associated with hunger, thirst, or sexual desire raises activity levels in the direction of those basic needs but does not appear to evoke a corresponding sense of satisfaction or satiety. It is interesting, also, that such stimulation does not appear to produce a sense of frustration or anger. On the contrary, the sensation of desire or appetite is immensely rewarding for many animals. The stimulation of neural sites associated with appetence for food may be rewarding because it simultaneously elicits cortical representations or imaginings of pleasurable affects previously associated with the satisfaction of hunger.

Observations from electrical self-stimulation experiments provide general neurological support for a deprivation theory of reinforcement (Premack, 1965; Timberlake and Allison, 1974). For any particular stimulus (or response) to be rewarding, an animal must feel a need or appetite for it. The hedonic direction of any behavioral consequence (i.e., its reward or punitive value) depends on the animal's relative deprivation or approach/attraction toward the item or opportunity in question. The drive or incentive to work for food may be experienced by hungry dogs as a conditionally rewarding state (drive induction), whereas the acquisition of the desired item (under the motivation of hunger) is an unconditionally rewarding event (drive reduction). Reinforcement, therefore, hinges on two distinct but interdependent functions: appetence and consummation. Without the presence of both factors, the reward may not be reinforcing. For example, food for a sated dog may actually be aversive, just as an opportunity to play could be punitive if the dog is overly tired or is sick. The hypothalamic activation of hunger sites both propels dogs into appropriate goal-directed behavior and provides conditional, positive reinforcement to the animals for doing so. Gray (1971, 1991) has postulated a behavioral activation system (BAS) facilitating these functions of brain-coordinated conditional reward or punishment. A feedback system appears to exist in which the animal is systematically guided toward stimuli promising satisfaction of a particular drive versus the avoidance of stimuli promising dissatisfaction or having been

associated with previous punishment. Gray speaks about the role of hypothalamic reward sites in this regard:

> We suppose that stimuli which regularly precede the occurrence of a reward themselves acquire the capacity to activate the reward mechanism; and that, the closer in time to the innately rewarding stimulus they occur, the stronger is this capacity. The reward mechanism is so constructed that, via connections with the animal's "motor" system (i.e., those parts of the brain which issue commands to the limbs), it strives to maximize such conditioned or "secondary" rewarding stimulation. In this way, given a stable environment in which sequences of stimuli recur with a degree of regularity, it is able to guide the animal towards the innately rewarding stimulus. We could, in fact, liken the reward mechanism to a homing or "approach" device of the kind used by a guided missile to aim up a heat gradient at the hottest spot around. (1971:183)

Such a functional neural arrangement regulated by the hypothalamus makes sense, considering the many moment-to-moment homeostatic roles that it serves. Behavior directed toward the acquisition of some biologically needed item or experience receives endogenous conditional reinforcement from reward sites associated with the needed item until it is obtained and general homeostasis secured. In carnivores, such a system of conditional reinforcement is particularly appropriate, considering the often sustained effort and arduous work required to locate and kill prey. Without endogenous conditional reinforcement, the animal's effort may wane or be redirected toward easier or more immediately rewarding activities.

Neurobiology of Aggression (Hypothalamus)

Many studies have demonstrated that the hypothalamus plays an important role in the expression of aggression. Two broad categories of aggressive behavior have been observed in the laboratory during intracranial stimulation: (1) quiet attack (predatory behavior) and (2) affective aggression (defensive and offensive displays) (Fig. 3.7). Electrical stimulation of the lateral hypothalamus results in the evocation of various predatory displays, including stalking, pouncing, and biting sequences. Quiet attack depends on the presence of a suitable prey object—that is, the evoked sequence is directed and dependent on a target. If an adequate target is not available, the stimulated animal may simply eat (if food is present) or become aroused and engage in searching or appetitive behavior involving sniffing and pacing. A differentiating feature of electrically stimulated predatory behavior is its emotionally *quiet* character. Quiet attack behavior occurs in the absence of visible agitation or sympathetic activation. Further, electrical stimulation of quiet attack behavior appears to be a hedonically pleasurable experience. Animals will self-stimulate

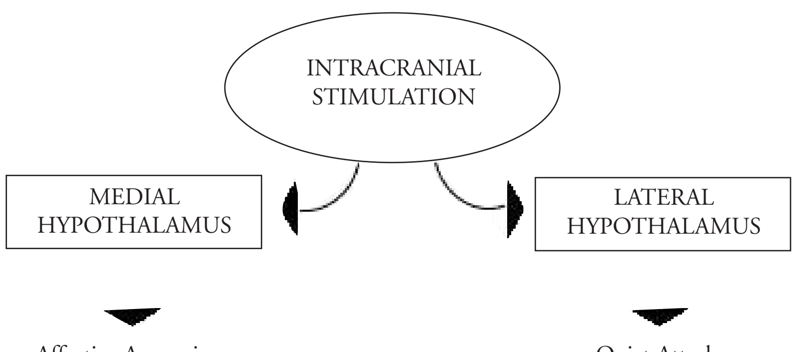

FIG. 3.7. Pathways mediating the expression of affective aggression and quiet attack (predatory aggression).

themselves through electrodes inserted into areas associated with quiet attack behavior (Panksepp, 1971). The reward experienced during stimulation of the lateral hypothalamus is similar to that seen during excitation of sites associated with drinking and eating. Essentially, quiet attack is an appetitive and consummatory response analogous to food or water seeking and ingestion.

Affective aggression is evoked by electrically stimulating the ventromedial hypothalamus. Unlike quiet predatory attack, affective aggression is a generalized response that may be targeted at any available object moving within the animal's reach. It is a highly emotional display associated with intense autonomic activation. In contrast to the pleasurable experience of quiet attack stimulation, intracranial stimulation of hypothalamic sites associated with affective aggression elicits a hedonically aversive experience that both cats and rats (and probably dogs) respond to as a punitive event. Research performed by Adams and Flynn (1966) appears to support this belief. They taught cats to jump on a stool to escape shock applied to their tails. After having obtained a vigorous escape response, they differentially stimulated sites in the lateral and medial hypothalamus and then compared the results on the previously trained escape response. Stimulation of the medial area resulted in strong escape responding in the cats, whereas stimulation of the lateral hypothalamus did not result in escape efforts. This different response to lateral versus medial stimulation supports the view that they are reward and punishment sites, respectively.

The Adams and Flynn experiment indicates that a linkage exists between affective aggression and escape behavior. Apparently, aggression is not only aversive to the animal, but it is also closely associated with painful stimulation and fear. Azrin and colleagues (1967) demonstrated that a definite relationship exists between aversive stimulation and the evocation of escape or attack behavior. Their findings show that escape is generally *prepotent* over attack; if attack ends the painful stimulation, however, it is easily conditioned as an avoidance response. Furthermore, during extinction (i.e., the phase of training where attack no longer served to postpone or terminate the aversive event) previously acquired attack behavior remained highly persistent and vigorous—even though it was consistently ineffective against the aversive event. The observations by Adams and Flynn are congruent with the prepotency theory of escape proposed by Azrin and coworkers. When sites typically associated with attack were stimulated, the cats tested readily emitted the learned escape response rather than attacking.

These laboratory observations are significant for understanding and controlling various forms of canine aggression. Tortora (1983) has developed a theory of aggressive behavior in dogs that incorporates a theoretical viewpoint that is consistent with the findings of Azrin and colleagues and the aforementioned research. He has argued convincingly that many common forms of canine aggression directed toward human targets are motivated by avoidance dynamics rather than an ethological causation like dominance-related competition. Many aggressive displays that are currently diagnosed as dominance aggression are, according to Tortora's analysis, aimed at avoiding some perceived aversive outcome rather than establishing or maintaining the offending dog's social status. Dominant dogs may be more prone to learn an active defensive coping strategy during social conflict in order to control (avoid or escape) aversive outcomes than a more submissive counterpart, but the underlying behavioral dynamics and motivations are not to enhance dominance status but simply to terminate a perceived threat. Within the framework of this model, subordinate or submissive dogs are more likely to react nonaggressively, that is, by freezing or fleeing—unless escape is prevented, whereupon they may attack as a last resort. Submissive dogs flee or freeze, not because of their lower relative status or some controlling deferential attitude, but rather because their primary mode of avoidance is flight or freezing. Both active and passive defensive modalities are aimed at avoiding an aversive or feared outcome.

Consistent with Tortora's viewpoint, Siegel and Edinger (1981) have argued that affective aggression appears to be neurally organized around the general purpose of self-preservation and survival. They have speculated that even such functionally disparate aggressive patterns as fighting, maternal aggression, and territorial defense may all be ultimately subsumed under the same general category of hypothalamically affective attack behavior. Evidently, stimulation of the same brain site evokes different forms of aggression, depending on the social and environmental conditions existing at the time.

Neurobiology of Fear

The study of fear has made tremendous strides during the past decade. Several interacting and self-regulating circuits in the brain have been identified. The auditory-neural pathways involved in classical fear conditioning have been mapped by LeDoux and his coworkers at New York University (LeDoux, 1996). Since auditory fears (e.g., brontophobia and other loud noises) are common among dogs, it is appropriate to review these important findings in detail.

Primary Neural Pathways Mediating the Classical Conditioning of Fear

Although all sensory modalities are capable of forming conditioned links with central fear circuits, the pathways active during auditory conditioning are the most fully known (LeDoux, 1994). Auditory information reaches the brain via relay nuclei located in the brain stem and thalamus. Such information follows two primary pathways: a slow circuit visiting cortical destinations before projecting into the amygdala, and a fast circuit directly terminating in the lateral amygdala. Slow and fast circuits are both engaged during fear conditioning, and each circuit is capable of establishing conditioned fear independently of the other. In the fast circuit, auditory projections from the thalamus (medial geniculate body) are received by the lateral nucleus of the amygdala and relayed to the central nucleus and other amygdaloidal areas, chiefly the basal and accessory basal nuclei. The aversive US appears to form direct links to the lateral amygdala and indirect ones via thalamic relays (Carlson, 1994). It is within this general network that the auditory CS is associatively linked with the fear-eliciting US.

Outputs from the central amygdala are subsequently processed by other limbic and cortical regulatory circuits. Efferent projections from the central nucleus terminate in the hypothalamus, producing a variety of discrete emotional and physiological expressions of fear. The specific manifestation of fear exhibited by an animal depends on the location of arousal. Amygdala projections reaching the central periaqueductal gray matter produce freezing, outputs to the lateral hypothalamus increase blood pressure, and connections formed with the paraventricular hypothalamus stimulate the release of stress hormones.

In addition to direct thalamic input, the amygdala also receives regulatory inputs from limbic and cortical portions of the brain, especially the hippocampus. This additional information converges on the amygdala to produce rich emotional variety, meaning, and subtlety. The combination of these various neural influences on the amygdala modulates and refines the dog's ultimate emotional response to stimulation. The organization of emotional expressiveness and its adaptation depends on the harmonious interplay and the efficient regulatory functioning of these various neural networks. Innate or acquired dysfunctions occurring in any one of these interdependent pathways result in emotional and behavioral disorder.

Habituating and Consistently Responsive Neurons

Unlike conditioned stimuli that acquire their fearful properties by being associated with other startling or traumatic events, fears of loud noises are biologically *prepared*. The sound of fireworks or thunder, for example, requires no associative conditioning in order to elicit fear reactions in a sensitive and predisposed animal (Menzies and Clarke, 1995). Stimuli that evoke fearful reactions without

conditioning appear to utilize *hardwired* neural pathways that are responsive only to a narrow range of stimulation and variability.

Recent research supports the hypothesis that a limbic substrate elaborates persisting unconditioned fear of loud noises. A series of experiments carried out by Fabio Bordi (see LeDoux, 1994) demonstrated that, within the lateral nucleus of the amygdala, two distinct neurons can be isolated: *habituating* and *consistently responsive*. By measuring activity in these cell groups, he found that the habituating cells eventually stop firing in response to repeated low-intensity acoustic stimulation. In contrast, however, consistently responsive cells are not subject to the effects of gradual habituation. Further, he found that only very loud noises activate consistently responsive cells. These cells invariably fire if sufficiently intense stimulation is produced by loud sounds.

It would seem reasonable to speculate that consistently responsive neurons in the amygdala mediate or play a significant role in the elaboration of loud-noise-phobic and thunder-phobic responses in dogs. These effects do not depend on learning but invariably result when a sufficiently intense unconditioned auditory stimulus is presented. A neural mechanism of this type may help to explain some of the difficulties associated with the treatment of thunder-phobic dogs. Because fearful responses to loud acoustic stimulation are unlearned and unresponsive to habituation, they would inherently resist behavioral training efforts.

It has been frequently observed that thunder phobia worsens with age. Although a dog may exhibit sensitivity to loud noises when young, the initial reactions are more or less under the animal's control. As the dog ages, and perhaps following a particularly intense exposure, its ability to cope with its fear of thunder may be compromised. This situation is particularly evident in dogs exhibiting chronic separation distress. These observations support the possibility that some neurological change may be occurring that compromises the dog's ability to cope with fear over time, although much more study in this area is needed before any firm conclusions can be drawn.

A possibility, though, of considerable interest involves the breakdown of regulatory control of the hippocampus. The hippocampus performs a regulatory function over the expression of fear. Under conditions of repeated or prolonged stress, the hippocampus may undergo degenerative changes that alter its ability to perform these functions. On the other hand, the amygdala appears to function more efficiently under stress. Over time with the impairment of hippocampal regulation, the strength of amygdaloidal outputs may be increased, with the appearance of excessive fear. Under conditions of fear, the hippocampus undergoes further degeneration, with increasing susceptibility to fear and the manifestation of increasingly exaggerated expressions of it. Besides the influence of possible hippocampal damage due to stress, strong evidence indicates that learning under fearful conditions is especially persistent and augmented by the facilitating presence of epinephrine. The potentiated response to thunder or anticipatory conditioned stimuli (atmospheric changes, lightning, etc.) exhibited by phobic dogs may be the combined accumulated effects of enhanced fear learning and stress. With these various effects in mind, it would make sense to consider pharmacological treatments that focus on the control or amelioration of negative stress effects and administering a medication capable of blocking epinephrine activity during thunderstorms.

Many thunder fears have a clear link with a specific event in a dog's past (Hothersall and Tuber, 1979), but many do not and instead follow a more gradual and progressively worsening course. Fears that have a specific link with an event in a dog's near past appear to be more responsive to simple counterconditioning efforts than fears developing over years of exposure.

Extinction of Conditioned Fear

Once conditioned fears are learned, they are encoded as relatively permanent emotional memories. These so-called *savings* are not subject to subsequent erasure through extinction (Kehoe and Macrae, 1997). Although

extinction efforts (repeated presentations of the CS without the US) can temporarily attenuate the fearful CS, extinction is subject to a number of well-known recovery effects (Bouton and Swartzentruber, 1991). As noted above, fear conditioning does not require the activation of cortical circuits, but in order to extinguish fear a significant amount of cortical involvement is required (LeDoux, 1994). The importance of higher neural mechanisms for extinction is evident in the failure of extinction to occur in animals suffering cortical lesions. Although robust conditioned fear responses can be obtained in spite of extensive cortical damage, such lesions dampen or entirely eliminate the effects of extinction. Extinction is a higher learning regulatory process that attunes conditioned fears to changing environmental conditions and organismic needs.

Three significant aspects of fear conditioning and extinction have important implications for the treatment of behavior problems involving fear:

1. Once fear is learned, it is probably permanent.
2. Although extinction and counterconditioning efforts may ameliorate aversive affects and reduce fearful responding, such training efforts are subject to reversal and the reinstatement of unwanted behavior.
3. Since the extinction of fear is subject to recovery, behavioral training should include efforts to enhance voluntary impulse control over fear-related behavior.

Brain Areas Mediating Contextual Learning and Memory

Previous learning and contextual cues serve to modulate fearful behavior. A tiger safely confined behind bars and glass in a zoo represents a significantly different stimulus in terms of fear-eliciting potential than one roaming free in public. Contextual cues serve an occasion-setting function signaling those times and places when the feared event is likely to occur. For example, a dog that has been previously attacked by another dog will become progressively more vigilant and defensive as it nears the place were the incident occurred. These various contextual cues associated with fear (and aggression) are organized by the hippocampus. Classical conditioning of specific fears (CS-US) are mediated by the amygdala, whereas fear associated with the context or configuration of stimuli present at the time of conditioning are mediated by the hippocampus. Contextual cues or configurations draw on information that is encoded and stored as nonsensory representations and relations.

Comparing the structural and functional differences between classical conditioning and contextual conditioning may help to explain how some fears are rapidly extinguished and others become persistent phobias. In the developing nervous system of mammals, the prominent systems of learning and memory mature at different rates and become functional at different times. Stimulus-specific fears mediated by the amygdala are operative early in the animal's life cycle, whereas contextually modulated fears are possible only after the hippocampus is functionally operative sometime around weaning (Jacobs and Nadel, 1985). This ontogenetic transition may play an important role in the appearance of the critical period for fear conditioning in 8- to 10-week-old puppies. Emotionally traumatic events occurring during this time can produce long-lasting fears. The period may be a vulnerable integrative phase articulating emotional and contextual learning. At the conclusion of this period, a puppy's contextual learning abilities and the various cortical regulatory influences mediated by hippocampus are ready for environmental exposure; in fact, this chain of events appears to follow the empirical evidence. As puppies near 10 or 12 weeks of age, they exhibit a more curious and confident attitude about exploring the environment extending beyond the immediate nesting site, making more and more ambitious excursions as they mature (Scott and Fuller, 1965). Besides exhibiting an increased interest in wider exploration of the environment, cortical articulation is evident in the observation by Nott that "puppies of this age gradually learn the relevance of their behav-

iours and are able to determine which behaviours are appropriate to specific situations" (1992:69).

The organization of learning and encoding of memories depends on the maturation of these different systems. The earliest fearful associations learned are encoded as unconscious or *implicit* memories. Although implicit memories are consciously inaccessible, they are not without widespread influence. Implicit unconscious memories activate physiological responses associated with fear. The conscious identification of the eliciting aversive stimulus and the context in which it occurred requires the participation of *explicit* memories formed by the hippocampus and related cortical systems. Explicit memories are the cold facts formed about the surrounding circumstances of fearful conditioning, whereas coordinated implicit memories provide the emotional content (Fig. 3.8).

Implicit and explicit memories are elaborated into conscious experiences through the integrative mediation of the working memory. The working memory system is a complex, short-term memory and neural organizing system of mental and sensory information that is intimately connected with conscious cognitive functions.

During fearful conditioning, both implicit and explicit memories are formed and are coupled together through the working memory so that they usually reach conscious attention together—but not always. This is especially the case involving memories formed before the full maturation of the hippocampus (or in cases where hippocampal functioning is disrupted). Typically, such early memories remain unconscious and inaccessible but under appropriate environmental stimulation are capable of evoking strong autonomous emotional responses via the visceral brain and body. Fear conditioning that occurs independently of the contextualizing influence of the hippocampus produces a number of characteristics that correspond to symptoms observed in phobias, especially a tendency toward excessive generalization and context independence. Although infantile fears are forgotten, they may be reinstated under the influence of stress. According to Jacobs and Nadel (1985), stress-inducing environmental conditions disrupt hippocampal contextualization of memories while potentiating context-free associations formed by the amygdala. As is discussed below, stress plays a prominent role in the learning and unlearning of fear.

AUTONOMIC NERVOUS SYSTEM–MEDIATED CONCOMITANTS OF FEAR

Several physiological changes occur with the onset of fear. These reactions are mediated by the hypothalamus through the autonomic nervous system in conjunction with various hormonal mechanisms. The overall picture is one of emergency and preparedness to act in the face of danger. Common physiological concomitants of fear include pupillary dila-

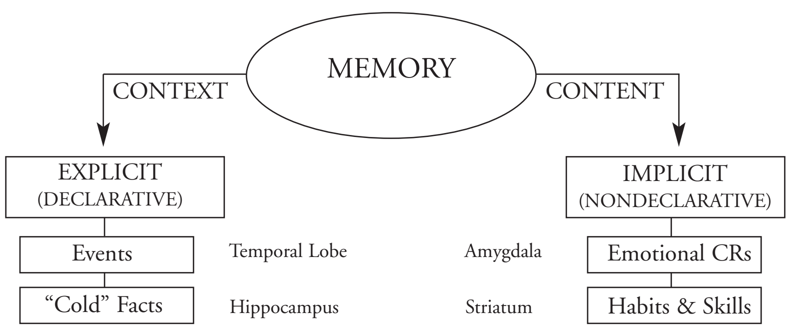

FIG. 3.8. Memory is functionally differentiated into explicit and implicit forms. Explicit and implicit memories depend on the operation of different areas of the brain. CR, conditioned response.

tion (mydriasis), retinal vasodilation (resulting in a reddish glow of the eyes), piloerection (hair standing on end), hypoalgesia (loss of sensitivity to pain), loss of appetite (both food and water), hyperpnea (rapid panting), alimentary irritability with diarrhea, increased perspiration (seen on the pads of the dog's feet), tachycardia (faster heart rate) with harder contractions, and reflex potentiation (stronger startle and withdrawal reflex actions). An important concomitant of sympathetic arousal is direct stimulation of the medulla and the secretion of epinephrine (adrenaline). Epinephrine stimulates and augments sympathetic processes and enhances an animal's ability to flee or fight. Under the influence of intense fear, a dog may urinate, release the anal glands, or defecate. Chronic anxiety may result in polyuria and irregular urination patterns. Lastly, appetitive behavior like eating and drinking is suppressed by fear.

Fear and Biological Stress

Fear is closely linked with biological stress. Stress occurs when any demand is placed upon a dog that requires the dog to change or adjust. Although stress is most commonly associated with hedonistically aversive demands, it is not necessary that the stressor be aversive. Any biological or psychological demand, regardless of its hedonistic valence, can result in stress (Selye, 1976). Whereas healthy stress is an everyday occurrence, pathological stress is associated with disease activity or psychological trauma. Chronic fear and anxiety may lead to stress-related disease, including atrophy of lymphatic glands, immunosuppression, and gastric ulcers. In addition, stress associated with chronic fear may undermine the brain's ability to cope adequately with fear by causing various degenerative effects, especially involving the hippocampus and its restraining influences over the hypothalamus.

The stress response is mediated by a complex loop of interconnected neural and hormonal mechanisms. During fearful stimulation, sensory information relayed by the thalamus prompts the amygdala to instruct the periventricular hypothalamus to secrete CRF. Subsequently, CRF stimulates the anterior pituitary gland to release ACTH into the bloodstream. ACTH is a hormone that acts specifically on the cortex of the adrenal glands, triggering the release of a variety of adrenal steroids. Once in the bloodstream, these hormones excite the emergency activation of a dog's bodily defenses.

Among the steroidal hormones secreted by the adrenal glands is a group known as the corticoids, which include both inflammatory (aldosterones) and anti-inflammatory hormones (cortisol). In addition to its anti-inflammatory effects, cortisol also serves to calm fearful dogs while preparing them for action. Human subjects undergoing corticosteroid therapy report feeling an increased sense of well-being. It is likely that dogs experience a similar benefit. Urinary cortisol levels and other stress indicators (e.g., the presence of high levels of catecholamines) might well prove to be a valuable test for the detection of physiological changes associated with chronic anxiety. Beerda and coworkers (1996) compared urinary and salivary cortisol measures with the more invasive blood plasma measures. Both urinary and salivary samples provide equally valid measures of stress-induced cortisol activity in dogs. The researchers suggest that salivary cortisol measures may be particularly useful in quantifying acute stress reactions.

Neural Stress Management System and Fear Learning

The hypothalamic-pituitary-adrenal (HPA) axis is regulated by a biochemical negative-feedback loop controlled by cortisol levels dispersed in the bloodstream. High levels of circulating cortisol suppress ACTH via the suppression of hypothalamic CRF secretion. In addition, hypothalamic CRF production is modulated by the combined and opposing stimulatory influences of the hippocampus and amygdala. In the presence of a fear-eliciting stimulus/situation, the amygdala instructs the hypothalamus to secrete more CRF, whereas the hippocampus instructs the hypothalamus to slow down production of CRF. These excitatory and inhibitory control

mechanisms provided by the amygdala and hippocampus serve to match and tune an animal's physiological response to the actual circumstances of relative danger/safety present in the environment (Fig. 3.9).

Under conditions of intense fearful arousal, strong associative memories are encoded, often causing lasting emotional disturbances that fail to dissipate over time. The hormone epinephrine appears to play a significant role in the formation of traumatic memories. The urine of humans suffering traumatic experiences (post-traumatic stress disorder) contains elevated amounts of catecholamines (epinephrine and NE), possibly providing a peripheral measure and diagnostic criterion of trauma-induced stress (Kosten et al., 1987). In animals, retention of avoidance learning and aversive emotional memories is mediated by epinephrine and disrupted by epinephrine blockade (McGaugh, 1990). Rats, for example, given a post-training dose of epinephrine retain more about the training situation than untreated controls. McGaugh speculates that the mechanism mediating this facilitatory effect involves peripheral epinephrine (epinephrine is blocked at the blood-brain barrier) triggering opioid disinhibition of NE activity occurring in the amygdala. Interestingly, extinction occurring under response prevention contingencies is also facilitated by the administration of stress hormones (ACTH and epinephrine) shortly before carrying out response-blocked presen-

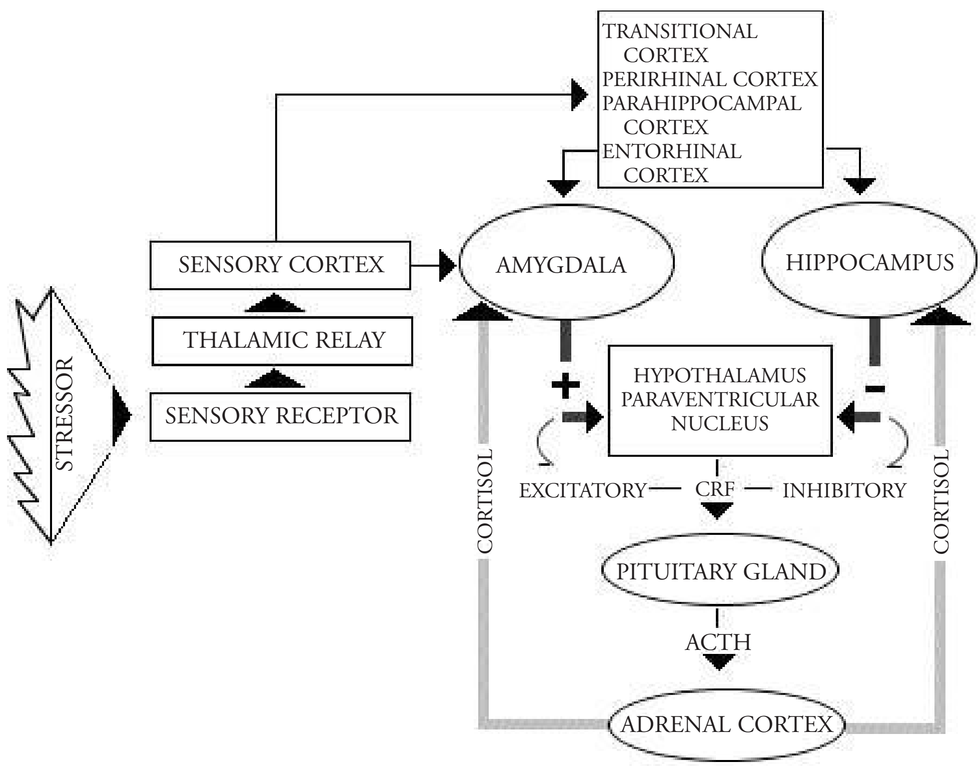

FIG. 3.9. Diagram showing the primary stress circuits. Note the bimodal modulatory effects of cortisol on the amygdala and hippocampus. In the amygdala, cortisol stimulates the transmission of signals to the hypothalamus that cause it to release corticotropin-releasing factor (CRF), whereas, in the hippocampus, cortisol exercises an inhibitory influence over the secretion of CRF. In sum, these influences regulate (augment or restrain) the activation of the physiological response to stress via CRF-mediated adrenocorticotrophic hormone (ACTH) release by the pituitary gland. After LeDoux, (1996).

tations of the aversive CS (Richardson et al., 1988). Riccio and Spear suggest that the hormonal enhancement of extinction is attributable to the reenactment of a more complete internal representation of the original fear occurring when the aversive CS is presented without the US:

> Further investigation is needed, but this finding is provocative in suggesting that, in addition to cognitive information about contingencies, elicitation of an affective response may contribute importantly to the elimination of fear-motivated behavior. (1991:232)

An opposite effect on learning appears to occur in the presence of endogenous opioids and narcotics (McGaugh, 1990). Opiates exert a strong inhibitory influence over noradrenergic neurons—an effect that is blocked by the administration of opioid antagonists (e.g., naloxone). NE-producing neurons projecting to the amygdala appear to play an important role in the retention of aversive associative learning. When narcotics are administered after aversive training, they interfere with the retention of fear conditioning. Also, increased opioid activity in the amygdala reverses the facilitatory effect of epinephrine on memory.

The memory-enhancing effect of epinephrine is dose dependent, with high doses stimulating the memory-blocking activity of the opioid system. These observations suggest that the brain may actually have a built-in memory modulating or "erasing" mechanism associated with particularly aversive traumatic events. During times of intense sympathetic arousal when large amounts of epinephrine are secreted, stressful memories may be disrupted or prevented from forming. These findings are highly suggestive with regard to the persistence of some conditioned stimuli to extinction. Fanselow (1991) notes that aversive conditioning results in conditioned stimuli capable of evoking endogenous opioid production. Consequently, the presentation of the aversive CS in the absence of the US may impede extinction of the CS by eliciting the simultaneous release of beta-endorphins, thereby physiologically obstructing the reenactment or representation of the original fear-conditioning situation.

In general, though, emotionally significant events are better remembered than nonemotional ones. An interesting implication of these findings is the possible beneficial effects of blocking adrenergic activity shortly after the occurrence of traumatic events. LeDoux (1996) has suggested that the administration of an epinephrine-blocking agent may serve as a prophylaxis against the development of lasting fears, negative memories, and the elaboration of emotional disorders following a traumatic experience. Since, as already noted, the brain opioid system appears to interfere with memory formation and retention, it may not be such a bad idea after all to take a good stiff drink following a particularly traumatic event. A potential implication of these findings for dogs is that increased opioid activity might reduce learned social fears following agonistic encounters, perhaps facilitating subsequent reconciliation between combatants, as well. Evidence from rodent studies suggests that strong opioid activity does occur following defeat. Miczek (1983) found that mice confronted with inescapable defeat experience a "large, lasting pain suppression" that appears to be mediated by endogenous opioid activity. Endorphins have also been shown to reduce affective aggression. If a similar phenomenon is present in dogs, this may have potential value in understanding some important aspects of dog social behavior. The emotions associated with submission are clearly of a different origin and quality than those associated with fear and avoidance, the former of which may include some element of fear but, in addition, is well buffered with very strong affiliative overtones. Submissive dogs do not avoid dominant opponents but accept defeat and adopt a subordinate role without an appearance of lasting fear. The possible facilitatory social function of opioids following defeat is consistent with the proposed general role of endogenous opioids in the formation and maintenance of social attachment and bonding among dogs (Panksepp, 1988; Hoffman, 1996).

Stress-related Influences on Cortical Functions

The disruptive influences of stress extend beyond the limbic feedback loops and the HPA system. In addition to the impact of stress on subcortical and physiological mechanisms, acute and persistent stress can generate pronounced dysregulatory effects over higher cortical activities as well. As already discussed, the prefrontal area serves many vital integrative and executive functions, which include impulse control and the coordinated regulation of behavioral systems needed to meet the various internal and external demands placed on the animal to adjust. The provision of a flexible adaptational interface between the organism and the environment appears to be a prominent function of the prefrontal cortex. This prefrontal function is mediated by learning and the exertion of inhibitory and modulatory influences over subcortical processes. Under the adverse conditions of excessive stress, however, subcortical activities are amplified while, at the same time, corresponding cortical regulatory functions may be temporarily disrupted. In particular, acute stress has a robust excitatory effect on the amygdala, which, in turn, coordinates the expression of numerous preparatory systems that mobilize an organism for impending emergency action. During such stressful activation, increased levels of NE and dopamine are released in the prefrontal cortex. Although increased catecholamine activity appears to have a facilitatory effect on subcortical processes, the release of these neurotransmitters in the prefrontal area has an opposite effect, causing it temporarily to suspend its efficient functioning. Instead of enhancing prefrontal functions, as it does in the amygdala, increased dopamine (especially involving D_1 receptors) tends to suspend or disrupt cortical restraint over subcortical activity (Arnsten, 1998). As a result, the benefits of previous learning, impulse control, and social inhibition may be momentarily compromised or turned off, with control taken over by species-typical offensive and defensive action patterns. Under the influence of stress, the behavioral thresholds for these innate patterns are lowered while, simultaneously, their expression is amplified by limbic pathways enhanced by increased catecholamine and CRF activity.

These changes point to several significant effects of stress on the behavior of dogs. Foremost is the possibility that stress-mediated activation of the nervous system may disrupt normal cortical control over the expression of undesirable behavior associated with fear and anger. The foregoing findings underscore the importance of canine husbandry and management efforts that strive to reduce stressful influences in a dog's environment. Unfortunately, stress is a fairly ubiquitous phenomenon in the life of most dogs. Among the most common sources of adverse stress are excessive confinement, insufficient exercise and attention, sensory distress (e.g., exposure to loud noises), separation distress, poorly predicted and uncontrollable training events (especially excessive punishment), and frustration. The loss of predictability and control over significant aversive and appetitive events results in increased anxious arousal and frustrative persistence—both sources of stress associated with the development of many behavior problems. Although the connection between anxiety and the physiological mobilization of stress is well known and recognized, frustration is also an important source of stress (Coover et al., 1971). The combined influence of such behavioral sources of stress on the elaboration of behavioral dysfunction and disorganization are discussed at length in Chapter 9, which is dedicated to the influence of adverse learning conditions on behavior.

Exercise and the Neuroeconomy of Stress

Counteracting the effects of stress depends on a twofold process of altering the environment and providing training and socialization activities that are both highly predictable and controllable. Another common recommendation used to counteract the adverse effects of stress is exercise. The experimental study of exercise indicates that it exerts a considerable, and potentially therapeutic, influence on the physiology of dogs. For example, Radosevich and colleagues (1989) demonstrated that moderate exercise produces pervasive modulatory effects on both peripheral and central

endocrine activity in dogs. In addition to the release of various HPA system hormones (beta-endorphins, ACTH, and cortisol), exercise also increases the production of NE. Surprisingly, under conditions of low-intensity exercise (running a treadmill at 4.2 miles/hour on a 6% incline for 90 minutes), a coordinated and commensurate increase of beta-endorphins and ACTH was observed; whereas, in the case of high-intensity exercise (4.2 miles/hour on a 20% incline for 90 minutes), the expected trajectory of increased production of these substances did not proceed linearly—that is, the release of beta-endorphins and ACTH is *dose dependent* on the amount of exercise received. Also, the cerebrospinal fluid (CSF) of exercised dogs contains greater amounts of NE.

Many studies with animals (especially rodents) have shown that neurotransmitter activity is influenced by exercise (Meeusen and DeMeirleir, 1995). Although acute and forced treadmill exercise appears to deplete NE stores in the brain (as observed in learned helplessness) and is physiologically stressful for animals, chronic exercise appears to enhance noradrenergic activity and increases the amount of NE stored in several parts of the brain. Besides enhancing noradrenergic activity, exercise was also found to increase serotonin levels in the central amygdala (Chaouloff, 1997). These combined influences are believed to be responsible for some of the beneficial mood effects associated with exercise.

The finding that exercise enhances serotonergic activity is of considerable importance with respect to the use of exercise for the management of stress-related behavior problems. Within the brain's neuroeconomy, serotonin plays an important modulatory role over stress and the control of undesirable impulsive behavior. Promising evidence in support of a functional link between serotonin production and exercise has been reported by Dey and his associates (1992), who demonstrated a significant alteration of central serotonergic activity in rats exposed to chronic exercise. Daily exercise was found to generate pronounced and sustained enhancement of serotonin metabolism in various areas of the brain, including the cerebral cortex. The authors suggest that the cortex is the most likely neural site mediating the beneficial effects of exercise over depression. They refer to other research with rodents that has shown that experimentally induced depression produces a decreased level of serotonin in the frontal area. Signs of depression in these animals were reversed by administering microinjections of serotonin into the frontal cortex, whereas similar microinjections of NE, dopamine, and gamma-aminobutyric acid failed to alleviate depression similarly. Interestingly, Dey (1994) found that long-term exercise (4 weeks) had a pronounced immunizing effect on rats exposed to stress-induced depression. Chronic exercise prevented the signs of behavioral depression and generated a "remarkable enhancement" of 5-HT_2 receptor subtype responsiveness. In general, the response of serotonin receptor subtypes to exercise was very similar to the effects produced by tricyclic antidepressants. A similar effect has been reported by Chaouloff (1997) with respect to NE. He found that exposure to chronic and free-choice wheel running has an immunizing effect against NE depletion resulting from uncontrollable and inescapable foot shock.

The aforementioned studies support the hypothesis that exercise, especially daily and long-term exercise, has potentially beneficial effects on the neuroeconomy of the dog. Many dog-behavior consultants and trainers have long recommended exercise for the amelioration of a wide variety of behavior problems. Although the research is far from conclusive, the beneficial influence of exercise in combination with appropriate behavioral (e.g., basic training and behavior modification) and environmental interventions is a sensible approach to the management of stress-related behavior problems.

Neurobiology of Compulsive Behavior and Stereotypies

Emotional conflict and stress are considered to be significant etiological factors underlying the development of compulsive behavior disorders (CBDs). In addition, there is growing evidence linking CBDs with various neurological sources of causation. Wise and

Rapoport (1989) have argued that basal ganglia dysfunction underlies obsessive-compulsive disorder (OCD) in humans, reporting various historical and contemporary sources of evidence implicating its functional role. They evaluate two functions of the basal ganglia in support of their hypothesis: (1) the basal ganglia may be "repository for innate motor programs" (fixed action patterns), and (2) the basal ganglia performs a gating function over various sensory inputs (releasers). In addition, some sophisticated experimental work with OCD has identified a basal ganglia connection. For example, microinjections of amphetamine into the ventrolateral striatum results in compulsive forepaw licking in rats. The injection of a dopamine antagonist reverses the oral stereotypy (Stein et al., 1992). Luxenberg and colleagues (1988) discovered through x-ray computed tomography (CT) that the caudate nuclei of persons exhibiting OCD are bilaterally smaller than in persons not exhibiting the disorder. Another neuroimaging study implicating caudate involvement was performed by Baxter and coworkers (1987). Through positron emission tomography (PET), the researchers found that the caudate nuclei of OCD patients exhibits a higher glucose metabolic rate than that of controls. Lastly, horses challenged with apomorphine (a dopamine receptor stimulant) exhibit increased oral activity and compulsive licking and other oral stereotypies—symptoms that worsen with increasing apomorphine dosages (Fraser, 1985). Also, tight-circling behavior is induced in rats as the result of intracranial (striatal) microinjections of apomorphine (Koshikawa, 1994). These various studies suggest dopamine pathways play a mediational role in the elaboration of compulsive behavior and stereotypies.

In addition to the neural sites just discussed, an endogenous opioid mechanism has been suggested to play a role in the etiology and maintenance of certain CBDs. Both ALD in dogs (Dodman et al., 1988; White, 1990) and cribbing in horses (Dodman et al., 1987) are influenced by endogenous opioid activity. In these studies, a narcotic antagonist was dispensed to the affected animals. The drugs (naltrexone and nalmefene) effectively impede endogenous opioid activity by blockading opioid receptor sites. Evidently, some opioid mechanism underlies licking and cribbing, since both oral stereotypies were significantly reduced under the influence of the medication. Although significant benefits were observed in both dogs and horses, the decrement of compulsive behavior is drug dependent, with symptoms recurring soon after the narcotic antagonist was withdrawn.

As a word of caution, note that the endogenous opioid mechanisms involved in compulsive behavior are not fully understood. Although a connection has been established between compulsive behavior and opioid activity, it has not been determined how endorphins are related to compulsive behavior and vice versa—that is, it is not clear whether endorphin activity is causal or consequential to compulsive behavior. A couple of important questions need to be settled with regard to the role of endorphins in ALD and tail chasing: (1) does increased central endorphin activity precipitate (or facilitate) compulsive activity, or (2) is compulsive licking or tail chasing more primary in the chain of events—that is does self-stimulation in response to stress produce greater endorphin activity, thereby representing a kind of self-medication for a stressed or bored dog.

Additional support for a neurological causation is provided by the palliative effects of tricyclic antidepressants like clomipramine (Anafranil) and SSRIs, such as fluoxetine (Prozac), in its management. The efficacy of SSRIs implicates a serotonergic pathway, perhaps regulating a dopaminergic system at some level of organization. A report by Brown (1987) noted the reduction of fly-catching episodes and associated hyperactivity in a dog placed on a low-protein diet. The author concluded that the beneficial effect of diet change was due to a dietary allergy. However, another possibility underlying this improvement is a serotonergic connection via enhanced tryptophan transport through the blood-brain barrier (Ballarini, 1990). Evidence of direct serotonergic involvement has also been discussed in the literature. For instance, Jacobs and colleagues (1990) noted that a serotonergic subsystem within the dorsal raphe in cats is stimulated during licking and self-grooming. It is not known, however,

whether the increment of neural activity is due to the action of oral movements or sensory feedback caused by such movement. Rapoport and colleagues (1992) extrapolated from these findings to the possibility that a dysfunction may exist in a similar system in some dogs suffering with licking disorders like ALD.

Other neural substrates have been implicated in the etiology and control of compulsive disorders. Uhde and coworkers (1992) reported, in passing, some alleged success in controlling ALD with growth hormone supplementation. Crowell-Davis and colleagues (1989) reported a case involving various compulsive symptoms, including hyperactivity, self-licking, and fly catching. The dog was observed to be especially symptomatic when in the presence of its owner. When isolated, most of the dog's compulsive behaviors abated, suggesting an attention-seeking or anxious-arousal mechanism of some sort at work. Despite such indications, the clinicians discovered that the dog exhibited EEG patterns that were consistent with epilepsy. Subsequent treatment with phenobarbital proved effective in controlling the dog's behavioral symptoms.

The HPA system has been implicated in the expression of compulsive behavior. Growing evidence suggests that a significant role is played by ACTH in the release and maintenance of compulsive ritualization (Swedo, 1989). ACTH is released under various circumstances of increased autonomic arousal and stress, including conflict and exposure to novelty. Rats injected intracranially with ACTH exhibit increased self-grooming behavior. Following intraventricular injection of ACTH (lateral ventricle), rats spent as much as 90% of their time over an hour engaged in self-grooming activity. ACTH-induced grooming is topographically similar to grooming exhibited by rats under conditions of novelty and conflict. It has been found that ACTH-induced grooming can be reduced with opioid antagonists (naloxone and naltrexone) and enhanced with low doses of morphine. Both ACTH and beta-endorphins are produced in the pituitary as part of a generalized response to stress. The subsequent release of peripheral cortisol by the adrenal cortex appears to play a regulatory role over the production of both beta-endorphins and ACTH, thus limiting the extent of their activation via a negative-feedback loop. Cortisol may also influence noradrenergic neurons, as well as provide a regulatory function over the blood-brain barrier. One can speculate on how this might impact on the transport of nutritional precursors like tryptophan and, indirectly, on how the serotonergic system may be secondarily affected by the cortisol-regulated mechanisms mobilized by stress.

Neurobiology of Attachment and Separation Distress

MacLean (1985) has proposed that the neural substrates mediating separation distress, maternal care, and play belong to the same paleomammalian portion of the limbic system. According to his theory, these social behavior tendencies are all elaborated within the cingulate cortex and related neural structures. He has argued that the "separation call" or distress vocalization is the mammal's "earliest and most basic" vocalization pattern. More primitive forms of animal life (e.g., reptiles)—lacking a cingulate cortex—do not display evidence of maternal care, separation-distress vocalization, or play. Socially directed vocalization patterns may have originally evolved to maintain close contact between the mammalian mother and her immature offspring. In addition to maternal caregiving and separation distress, play between conspecifics also appeared with the evolution of mammals, perhaps serving to facilitate social harmony among litter mates.

Panksepp (1982) also views distress vocalization as stemming from a primal mammalian emotional system but more specifically originating in those areas of the brain that mediate panic and explosive behavior. In addition to the cingulate gyrus, other brain sites that contain dense concentrations of opioid receptors are implicated in the organization of attachment and separation distress. These areas include the amygdala, dorsomedial thalamus, hypothalamus, and the central gray area:

> It is proposed that sites from which distress vocalizations and explosive agitated behavior can be elicited represent the approximate trajectories of panic circuitry, the major adaptive function of which is to sustain social cohesion among organisms whose survival depends on reciprocity of care-soliciting and care-giving behaviors. (Panksepp, 1982:414)

These various areas of the brain and interconnecting circuits are stimulated by the differential presence or absence of pertinent social stimuli evoking or allaying social distress and panic.

Limbic Opioid Circuitry and the Mediation of Social Comfort and Distress

Both MacLean and Panksepp have noted the existence of a highly concentrated pattern of opiate receptors in the neural circuits believed to mediate social comfort, separation-distress reactions, and various other relevant emotional responses. Panksepp's lab has performed numerous studies demonstrating a direct linkage between brain opioid activity and the elaboration of separation distress, contact comfort, and play (Panksepp et al., 1984). After many years of study investigating imprinting and isolation-induced distress in ducklings, Hoffman (1996) has concluded, along with Panksepp, that social attachment and bonding is probably mediated by opioid receptors activated in the presence of adequate social stimuli. Social bonding and separation distress also appear to be closely related to opioid activity in monkeys. Keverne and associates (1989) at Cambridge University measured significant elevations of beta-endorphins in the cerebral spinal fluid of Talapoin monkeys upon being reunited with conspecifics after a period of isolation. In addition, they have found that social grooming among paired monkeys is probably mediated by an endogenous opioid mechanism. Monkeys exposed to naloxone blockade engaged in more grooming interactions, whereas low doses of morphine reduced such affiliative exchanges. A similar differentiating effect is observed among rhesus monkeys, where *cooing* (a primate separation-distress vocalization) is decreased by the administration of morphine and increased by naloxone (Kalin and Shelton, 1989).

Panksepp and colleagues (1980, 1988) found that low doses of morphine significantly reduce separation-distress vocalizations by puppies, guinea pigs, and chicks. In addition, the researchers demonstrated that socially deprived *kennel dogs* become more socially responsive and obedient after being administered low doses of morphine and more uncontrollable when given naloxone (Panksepp et al., 1983). Knowles and coworkers (1987) observed that well-socialized adolescent dogs (6 to 8 months old) exhibit increased care-seeking behavior (tail wagging and social contact) under the influence of naloxone, whereas morphine reduces such social behavior. It should be noted that initial efforts to demonstrate a relationship between naloxone and separation-distress vocalization in puppies failed. Although these early efforts failed to show a relationship between naloxone blockade and separation-distress vocalization, the researchers did find a significant relationship between naloxone and other canine social behavior patterns, including separation distress, when an intermittent operant element was involved:

> Recently we have measured other care-soliciting behaviors in the dog, and we find that naloxone can facilitate tail-wagging and face-licking. Also, we have recently observed that naloxone facilitates vocalizations in dogs when there is the possibility of a clear operant component. For instance, in several litters of puppies being tested for social motivation, we have observed naloxone-treated animals to vocalize more frequently when they are intermittently prevented from making social contacts. Accordingly, our failure to see a clear facilitation of DVs [distress vocalizations] in puppies following naloxone in a simple separation situation does not constitute a negation of the hypothesis that opioid-blockade should increase care-soliciting behaviors. (Panksepp et al., 1980:476)

Additional evidence for an opioid mechanism mediating social emotion and attachment has been reported in rodents by D'Amato and Pavone (1993), who measured differences in pain thresholds between mice paired with siblings versus controls paired

with unrelated mice of a similar age. Following 2 months of separation, reunited sibling mice exhibited a significantly higher pain threshold than controls. The full expression of the analgesic effect following the reunion of siblings took approximately 2 hours. The researchers found that the effect was blocked with the administration of naloxone, confirming the involvement of an opioid mechanism.

Not surprisingly, separation distress and panic manifest themselves behaviorally like symptoms of withdrawal from narcotics.

Hippocampal and Higher Cortical Influences

In addition to the aforementioned subcortical circuits, cortical systems are probably also involved in the regulation of separation distress, enabling dogs to cope with separation without experiencing excessive worry or panic. The amount of separation distress expressed by a dog appears to depend on the additive effects of social loss together with the relative novelty of the situation (time and place of separation) in which isolation occurs. For example, many adult dogs exhibit their first dramatic episodes of separation distress (excessive barking or howling, destructive chewing, or elimination problems) only after the family moves into a new home. Other dogs will remain relatively quiescent as long as they are confined in a familiar part of the house and the owner keeps a regular schedule. However, if they are confined in an unsocialized area (e.g., the basement or garage) or if the owner leaves early or returns late, they may become overly anxious and panic. The most intense separation-distress reactions appear to occur when a dog is left alone in an unfamiliar place. This general observation has been experimentally demonstrated with puppies by J. P. Scott and his associates (1973).

The central issue being raised here is whether two converging neural circuits (subcortical and cortical) might contribute modulatory influences over separation distress. Specifically, the hypothesis being advanced is whether two complementary circuits are involved: a circuit that is responsive to the loss of socially significant stimuli, and a second one that is activated by contextual considerations like location (familiar/unfamiliar) and schedule (predictable/unpredictable). An analogous situation occurs in the classical conditioning of fear. During the conditioning of fear involving an acoustic CS, the auditory signal (e.g., tone) generated in the ear is directed via thalamic auditory relays to the amygdala, where it is associated with the fear-eliciting US (e.g., shock). The fearful association between the tone and shock is thereby learned and permanently stored as an emotional memory connecting the CS with the US. However, the animal must also learn in what contexts the fear-eliciting CS is really threatening. Such contextual learning depends on the additional involvement of a complex hippocampal-cortical circuit, which results in the production of consciously accessible memories defining the exact situations (time and place) in which the CS predicts an actual threat (LeDoux, 1994). Under conditions of chronic stress, these various contextualizing functions of the hippocampus may be disrupted. A great deal of evidence suggests that excessive and chronic stress produces degenerative effects on hippocampal regulatory functions (McEwen, 1992). On the other hand, as noted above, these same conditions of stress appear to augment amygdaloidal functions, potentiating emotional learning and responsivity associated with conditioned fear. In the case of separation-distressed dogs, it would seem reasonable to suppose that hippocampal functions may also undergo a similar progressive deterioration as the result of chronic stress associated with the disorder. The neural degenerative effects of stress may help to explain why separation-reactive dogs fail to adjust to the effects of chronic separation distress. It may also provide a possible clue for the higher incidence of other fears and phobias (especially fear of thunder) presenting with separation anxiety.

In the case of separation distress, traumatic experiences associated with the loss of significant social stimuli may be stored as inaccessible emotional memories (manifesting as a persistent and unmodifiable dread of being alone). Along similar lines of contextual

learning in the case of fear, the context or situation in which separation occurs may also serve to modulate significantly the amount of anguish and distress expressed via consciously accessible memories of past experiences with separation and the participation of higher cortical coping mechanisms and control. Context may be defined here in terms of both spatial as well as temporal parameters, that is, referring to the place where the dog is confined, as well as the owner's schedule of departures and returns. In general, one might predict that as contextual familiarity and regularity (place and schedule) increase, the magnitude of separation distress should decrease. This seems to be precisely what occurs when dogs are successfully treated for separation-related problems. Whether such a regulatory coping circuit exists is not definitively known, but I would be surprised to discover that it did not.

Stress and Separation Anxiety

In addition to the HPA system readying the body for emergency action, another important CRF-mediated circuit within the brain itself modulates emotionally stressful states resulting from the distress and panic associated with social separation. Panksepp and colleagues (1988) describe an experiment in which CRF was intraventricularly injected into the brains of young chicks. The chicks exhibited pronounced distress vocalizations for 6 hours, even though they were in the presence of social stimuli that normally inhibited such reactivity. Within the CRF brain system, NE counterbalances and restrains CRF activity. Under conditions of prolonged stress, NE is depleted, resulting in the disruption of homeostatic balance between NE and CRF. Some CRF projections terminate in the area of the locus coeruleus and, perhaps, under conditions of chronic stress, CRF may exhaust the production of NE or, in conjunction with a parallel neuromodulatory system (e.g., the opioid system), impede efficient NE production. In addition to CRF-mediated activation of the locus coeruleus, CRF projections innervate the dorsal raphe.

It is known, for example, that endogenous opioids exercise a strong inhibitory restraint over NE-producing neurons (McGaugh, 1990). Under conditions of stressful regulatory imbalance, CRF-facilitated influences may prevail over the mood-enhancing influences of NE. Lowered levels of NE are associated with depression, and not unexpectedly many dogs suffering chronic separation distress also develop signs of depression. In addition to CRF circuits, other neuroendocrine (prolactin and oxytoxin) circuits may also play important roles in the modulation and expression of separation distress (Panksepp, 1992).

Strong evidence suggests that early stressful experiences produce lasting changes in the CRF stress-mediating systems of the brain. Relatively brief doses of separation distress produced by periodically removing rat pups from their mothers before they reach 21 days of age produce long-term changes in the rat's brain (Nemeroff, 1998). These early exposures to stress appear to alter permanently the CRF gene expression and, consequently, the rat's stress management system. These changes include the elevation of central CRF and proliferation of CRF receptor density, thereby intensifying the animal's response to CRF throughout its life. In addition to CRF system changes, early stress exposure elevates stress-induced ACTH secretion as well as plasma cortisol levels. Interestingly, the SSRI paroxetine (Paxil) appears to return CRF levels effectively to normal while adjusting the animal's increased receptor sensitivity to more normal levels, as well. In addition, the medication produces an overall reduction of undesirable fearful and anxious behavior. These palliative effects produced by paroxetine are apparently drug dependent. When treatment was discontinued, the earlier CRF levels, receptor sensitivity, and associated stress-mediated behavior returned to pretreatment levels. These findings suggest the possibility that early and repeated or traumatic exposure to separation may incline dogs to become overly responsive to stress-eliciting experiences, perhaps predisposing dogs to develop a variety of fear-related behavior problems and problematical separation anxiety as adults.

Finally, recent studies by Price and colleagues (1998) suggest that stress-related CRF system activation appears to exert a direct in-

hibitory influence over serotonin production in the dorsal raphe. This CRF-mediated restraint over serotonin production might obviously affect remote areas of the brain dependent on serotonin activity originating in the brain stem. The intimate link between CRF and serotonin output may help to explain the aforementioned stabilizing and serotonin-enhancing effects of paroxetine via CRF system regulation (or normalization). The evidence suggests that paroxetine might be a useful alternative for the management of stress-related behavior problems in dogs; however, currently it is not commonly employed by veterinary behaviorists (Overall, 1997; Dodman and Shuster, 1998). Considering the potential benefits, and the apparent lack of mitigating adverse side effects, perhaps some exploratory clinical trials with the drug should be carried out and evaluated.

Dexamethasone-Suppression Test

Clearly, a possibility exists that some functional dysregulation of the HPA system plays a role in the expression of adult separation-distress problems. Persons suffering depressive disorders frequently exhibit HPA dysregulation of cortisol production. To determine the presence of such dysregulation, depressed patients are administered an oral dose of dexamethasone (a synthetic cortisol), and plasma cortisol levels are measured at various times during the day. In persons exhibiting normal-functioning HPA system regulation, cortisol levels are suppressed; in persons exhibiting HPA system dysregulation, however, plasma cortisol levels are not suppressed. Some evidence indicates that children exhibiting severe separation anxiety show an abnormal response to the dexamethasone-suppression test (Livingston, 1991). Perhaps adult dogs exhibiting chronic or severe separation anxiety may suffer a similar dysfunction of HPA activity. The dexamethasone-suppression test might offer a diagnostic method for isolating such dogs from other dogs presenting with a more psychogenic etiology and symptomatology. Further, an abnormal dexamethasone-suppression test result appears to be moderately predictive of a positive response to antidepressant medications in human patients (Risch and Janowsky, 1986).

Psychomotor Epilepsy, Catalepsy, and Narcolepsy

Epilepsy

In cases of bizarre or unusual behavior occurring with little or no warning, one should suspect the possibility of a biological pathology involving the brain. Psychomotor seizure activity (limbic epilepsy) often presents with psychosomatic symptoms, like chronic vomiting or diarrhea (Reisner, 1991), and various behavioral signs. Although behavior problems associated with fear and aggression are typically viewed as learned patterns, some such patterns may be (in part or whole) the behavioral manifestation of seizure activity in the hypothalamus, limbic system, or temporal lobes (Aronson, 1998). The amygdala is particularly sensitive to seizure activity, perhaps an etiologically significant factor in the development of some forms of panic disorder and generalized anxiety. Holliday and coworkers (1970) studied 70 cases of canine motor epilepsy presenting with varying degrees of severity and duration. As the result of interviews taken with owners, they detected a number of behavioral sequelae occurring comorbidly with epilepsy in dogs, suggesting the possibility of a limbic system or temporal lobe involvement:

> Behavioral signs of varying duration and form were common before or after a generalized seizure or sometimes pre- and postictally. The behavioral abnormalities consisted of: wandering in circles, restlessness, somnolence, apparent blindness, viciousness, inappropriate barking, attacking inanimate objects, terror-stricken behavior, inappetence, voracious appetite, generalized trembling, champing of the jaws, licking movements, and behaviour as if one ear were painful. Such changes usually lasted a few hours at most, but were occasionally present for 3–4 days. In a few dogs the behavioral signs were the most prominent abnormality, appearing at times in the absence of generalized tonic-clonic seizures. (1970:283)

Unfortunately, such pathology is difficult to diagnose through conventional EEG tests done to verify somatomotor epilepsy. One way to determine whether a particular case is

precipitated by underlying limbic seizure activity is to compare the differential effects of epileptogenic drugs and antiepileptic drugs on the expression of the behavior in question. Borchelt and Voith (1985) have described a case involving a male Lhasa apso that, when presented with food, would begin eating, lift his head, growl, and whirl about attacking the surrounding area. The bizarre, poorly directed, species-atypical character of the behavior prompted a pharmacological test. It was found that the dog's aggressive behavior could be kindled by injecting him intravenously with chlorpromazine regardless of the social context or ongoing environmental stimulation. On the other hand, if the dog was given an oral dose of diazepam before eating, he ate peacefully without exhibiting any aggressive behavior.

Dodman and colleagues (1992) have reported three cases of what they term *episodic dyscontrol syndrome* (aggression), all of which appear to be associated with limbic seizure activity. The dogs (a Chesapeake Bay retriever, cocker spaniel, and English springer spaniel) exhibited fairly well-directed, although inappropriate and exaggerated, species-typical aggressive behavior. The episodes of aggression were found to be associated with several features that suggested limbic seizure activity. It was noted that the dogs exhibited various premonitory mood changes in the directions of increased irritability and depression, several autonomic signs (excessive salivation, pupillary dilation and glazing of the eyes, and vomiting), and intense aggressive behavior at a high frequency under low or no apparent provocation. All of the dogs proved responsive to phenobarbital therapy—a confirmatory indicator of seizure activity.

Catalepsy

Catalepsy is a condition in which dogs lose muscular control over the body, with full or partial collapse. Under full cataleptic loss of voluntary control, dogs may fall into a trancelike condition during which the limbs exhibit a plastic rigidity remaining in the form they are placed (Fox, 1968). A common example of catalepsy is tonic immobility, a phenomenon that is widespread in the animal kingdom and that may have a biological self-preservative function when an animal is faced with environmental threat (Gallup and Maser, 1977). The behavior has been described as *feigning death* or *protective inhibition*. A very familiar example of the behavior is exhibited by the opossum, a marsupial that uses tonic immobility as a primary mode of defense against predation. Cataleptic tonic immobility can be induced in a variety of ways: "The conditions for induction have included eye contact, pressure on body parts, repetitive stimulation, inversion, and restraint" (Crawford, 1977:89). Dogs that are abruptly rolled on their sides, following a brief struggle, are often absorbed into a state of tonic immobility. Tonic immobility might be part of a parasympathetic rebound effect in response to intense sympathetic arousal. Another interpretation conceptualizes tonic immobility and catalepsy as a response to conflict provoked by incompatible motivations between active and passive defensive mechanisms; that is, when an animal is threatened with imminent physical danger during which escape is not possible and attack is equally ineffectual, the outcome may be cataleptic immobility. Grandin (1992) has argued that the induction of tonic immobility is an elemental part of some taming processes in animals (e.g., wild horses), claiming that the firm touch calms while the light touch excites. She has designed a *squeeze machine* for the treatment of autistic and hyperactive children, claiming that physical pressure promotes a lasting sense of calmness and well-being. This may be relevant to the beneficial effects of forced lateral recumbency on some dogs. Dogs exposed to such restraint for several minutes are often significantly calmer when finally released.

Narcolepsy

Narcolepsy is a sleep disorder that, in humans, is associated with catalepsy and the rapid onset of sleep. In dogs, it appears to be genetically determined, with breeds such as the Doberman pinscher, miniature poodle,

and black Labrador retriever most often exhibiting the disorder (Voith, 1979). The condition is incurable. During episodes of narcolepsy, affected dogs move rapidly from an active state into a state of muscular weakness and collapse while apparently remaining in a trancelike conscious state. The onset of narcoleptic episodes is frequently associated with feeding times, during periods of general excitement, during or just after elimination, and sometimes during sexual activity. Regarding such attacks, Foutz and colleagues write,

> These attacks are frequently precipitated by the excitement of approaching desired goals, such as food, a play object or companion, or sexual activity. Some breeds such as Labradors often experience cataplexy more frequently when playing and exercising than when eating. Unpleasant experiences such as pain (caused by a hypodermic injection), fear, or parturition, do not appear to specifically elicit attacks. Cataplexy also appears to occur spontaneously. Very young puppies do not appear to be significantly responsive to food, but play activities are major precipitants for attacks. (1980:68–69)

Pavlov (1927/1960:319) appears to be describing narcolepsy when he writes concerning a highly inhibited dog that could not bear even a short delay of conditional reinforcement without becoming "drowsy and even fall[ing] asleep over its plate while taking the food."

Although the causes of narcolepsy are not definitively known, recent advances point to a dysfunction associated with the cholinergic innervation of the pontine reticular formation (PRF). Catalepsy associated with narcolepsy may result from the abnormal activation of these cholinergic mechanisms associated with the induction of REM (rapid eye movement) sleep. A colony of narcoleptic Doberman pinschers has been isolated and is currently being subjected to various experimental manipulations in an effort to determine the causal mechanisms involved. Reid and coworkers (1994) have directly measured ACh activity in the PRF via probes implanted into the pons of narcoleptic dogs. They have found a definite relationship between narcoleptic episodes and increased levels of extracellular ACh in the PRF of affected dogs. Interestingly, baseline levels of ACh in the PRF did not differ between controls and narcoleptic dogs.

The diagnosis of narcolepsy can be confirmed by EEG or by injecting narcoleptic dogs with imipramine. Reportedly, affected dogs quickly recover from the attack after being injected with the drug (Voith, 1979). In severe cases, CNS stimulants (*d*-amphetamine and methylphenidate) are sometimes prescribed to control the disorder (Foutz et al., 1980). Narcolepsy in dogs is often left untreated, since treatment is problematical (Hart, 1980). Medication with CNS stimulants may produce a variety of undesirable side effects and produce increasing tolerance over time.

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4

Sensory Abilities

Each animal has its own Merkwelt (perceptual world) and this world differs from its environment as we perceive it, that is to say, from our own Merkwelt.

NIKO TINBERGEN, *The Study of Instinct* (1951/1969)

DOGS ARE equipped with a number of specialized sensory organs evolved to obtain biologically significant information from the environment. These various sensory systems gather and process chemical, mechanical, and physical inputs, transduce them into coded electrical impulses, and then conduct the raw sensory data to the brain. Once in the brain, the sensory data are further processed and encoded into meaningful representations about the surrounding environment. The animal is totally dependent on the reliability of this information processing for the procurement of vital biological needs and all forms of adaptive learning.

The sensory capacity of dogs can be divided into three broad categories:

1. *Exteroception*: Exteroceptors are sensitive to all stimulation acting on dogs from the external environment. These stimuli (including light, sound, chemical agents [taste and smell], heat, cold, and pressure) correspond to the special senses of sight, hearing, taste, smell, and touch.
2. *Interoception*: Interoceptors are responsive to stimulation arising from within the bodily organs, such as emotional reactions and some muscular sensations.
3. *Proprioception*: Proprioceptors coordinate kinesthetic sensations and reflexes of the body, including the sense of balance.

VISION

Much of the close social exchange that occurs between dogs and people depends on the vi-

sual recognition of subtle gestures and postural signals. This visual information provides a sensory foundation for socially significant communication and harmonious interaction. Another important function of sight is to scan the environment for biologically important changes in the dog's surroundings not detected by the other senses.

Retina

The dog's eye is structured so that reflected light energy can be efficiently gathered and focused upon the retina, which is composed of light-sensitive neural tissue located at the back of the eye. There are two types of photoreceptor cells located in the retina: the *rods* (sensitive to contrasts of light and dark) and the *cones* (sensitive to variations in color and detail). A dog's retina contains many more rods than cones, with the latter comprising only 3% of all the photoreceptor cells found in the canine eye (Peichl, 1991). The preponderance of rods makes the dog's vision better suited for discriminating light and dark and detecting movement than seeing color and detail.

An important structural difference between the dog and human retina is the absence of a fovea. The fovea is a tightly concentrated area of cone and ganglion cells located at the center of the field of vision in the human eye. Nearly half of the human visual cortex is involved in representing information originating in the fovea (Thompson, 1993). Although not possessing a fovea, the central portion of the dog's retina does exhibit a higher concentration of cone cells than found in other retinal areas, with cones making up approximately 20% of all the receptors found there (Parry, 1953). Instead of possessing a fovea, the dog's retina contains a *visual streak* and a concentration of ganglion cells called the *central area.* The visual streak is an elongated oval concentration of light-sensitive receptors and ganglion cells situated along the central portion of the retina. The visual streak and central area are believed to play important roles in enhancing visual acuity, binocular vision, and horizontal scanning. Peichl (1992), who compared the visual streaks of dogs and wolves, found that wolf retinas consistently possessed a pronounced visual streak, whereas the visual streak in dog retinas varied considerably (moderate to pronounced) among the different breeds studied. He attributed these differences to the effects of domestication and breeding, thus providing additional physiological support for what Hemmer (1990) has termed the decline of "environment appreciation" in dogs and other domestic animals due to sensory and neurological degeneration resulting from domestic breeding (see Chapter 1).

Clarity of vision requires that an optical image is precisely focused on the retina. This function is achieved by the cornea, lens, and the aqueous media within the eye. Like humans, many dogs are either farsighted (hyperopia) or nearsighted (myopia). In the case of farsightedness the image is focused behind the retina, whereas in nearsightedness the image is focused in front of the retina. Myopia is not a general characteristic of canine vision (as has been sometimes suggested), but its incidence is relatively more common among certain breeds. For example, Murphy and colleagues (1992) found that 64% of the Rottweilers they tested were myopic. They also determined that 53% of the German shepherds tested (clinical population) were myopic, but, interestingly, of the German shepherds participating in a guide-dog program, only 15% were affected by the condition. This finding suggests that dogs with poor focusing abilities had been excluded from the guide-dog population as the result of other behavioral shortcomings arising during their training. Certainly, dogs like the German shepherd and Rottweiler should be tested for myopia before being trained for various utilitarian tasks requiring good eyesight.

Color Vision

Until recently, many dog authorities believed that dogs lacked color vision or, at best, it was considered a very weak aspect of canine vision. This opinion was based on early color-vision studies carried out by Smith (1912) and by Orbelli (1909, cited in Windholz, 1989) before him. Smith performed a series of color-brightness discrimination experiments (primitive by contemporary stan-

dards) with dogs and concluded that, although dogs appeared to exhibit a rudimentary ability to discriminate color, this ability was "highly unstable and cannot be supposed to play any part in the animal's normal existence" (Smith, 1912:190). Pavlov (1927) also reported disappointing results following a number of color-vision experiments performed by his laboratory associate Orbelli, whose early findings were consistent with Smith's results. During a series of color discrimination studies, Orbelli was not able to demonstrate a differential response to color, although he was able to achieve some apparent color recognition in one dog—a feat that was accomplished only after great effort and difficulty. Pavlov reported,

> The results obtained by other investigators, both Russian and foreign, lead to the conclusion that colour vision in dogs, if present, is only of a very rudimentary form, and that in most dogs it cannot be detected at all. (1927:132–133)

After several frustrated experimental efforts, Orbelli concluded that dogs did not differentiate between colors but rather responded to changes of brightness in the samples presented to them. However, other researchers during this same period—ostensibly implementing controls for brightness—reported conflicting results regarding color vision in dogs. A significant procedural difference between these experiments and the ones performed by Orbelli was the use of Pavlov's salivary method versus instrumental methods in which a dog is required to make a voluntary response indicating a choice between color samples. Experimenters using instrumental discrimination methods involving a voluntary response found that dogs did, in fact, possess some significant color vision. Stone (1921) criticized these early efforts to establish the existence of color vision in dogs, arguing that they had failed to control adequately for differences of brightness associated with the color samples presented. He suggested that positive studies indicating the presence of color vision in dogs were confounded by uncontrolled brightness factors, and concluded along with Smith and Orbelli that "the dog possesses only very rudimentary sensitivity to colors and depends very little, or not at all, on color distinctions in daily life" (1921:415).

The question of color vision in dogs has remained controversial ever since. However, highly controlled vision studies carried out by Neitz and colleagues (1989) and Jacobs and coworkers (1993) have demonstrated that dogs do possess significant abilities to perceive and use color. Neitz and coworkers, for example, determined through a series of color discrimination experiments (e.g., sample-matching discriminations) that dogs can differentiate dichromatic colors having spectral absorption peaks at 429 nm (blue-violet range) and 555 nm (yellow-green range). Spectral neutrality (colorlessness) was found to occur at 480 nm (i.e., the greenish blue range). The dog's dichromatic color vision enables a dog to discriminate bluish objects from yellow ones, but dogs are unable to differentiate between many other colors that are vivid to humans, for example, red, orange, and green—colors that dogs probably perceive as tints and shades of yellow or blue. The various colors that dogs see are affected by a composite of perceptual inputs other than saturated hue, for example, value (lightness/darkness) and intensity (brightness/dullness). Miller and Murphy (1995) noted that dogs are unable to differentiate between greenish blue and gray. This observation is based on findings by Neitz and colleagues (1989) that the range between 475 and 485 nm (greenish blue to humans) is spectrally neutral (i.e., colorless) to dogs. The dog's inability to discriminate between greenish blue and gray occurs, on the one hand, because a dog's dichromatic vision cannot perceive the greenish blue hue but, also, because the normal value of greenish blue is in the gray range. These current findings conflict with an earlier study performed by Rosengren (1969), in which dogs (three female cocker spaniels) were ostensibly trained to discriminate between red, blue, green, and yellow hues. In addition, she found that the dogs could distinguish these various colors from gray samples of different values.

In contrast to earlier reports indicating the existence of only minimal (if any) color vision in dogs, Neitz and colleagues (1989)

found that dichromatic color discriminations were rapidly mastered by the dogs they studied (two Italian greyhounds and a toy poodle), noting that color discrimination was evident after only a single day of training. They concluded that "color vision for the dog is not simply a laboratory curiosity, but rather may provide a useful source of environmental information" (1989:124).

Jacobs and colleagues (1993) confirmed the findings of Neitz et al. by means of sophisticated optometric instruments for measuring relative absorption rates of the photopigments contained in the dog's cone receptor cells (electroretinogram flicker photometry). They found that dogs, like the foxes, possess two different photopigmented cones that reach spectral absorption peaks at 430 to 435 nm and 555 nm, respectively. In the case of trichromatic vision, blue-sensitive cones reach absorption peaks at 420 nm, green-sensitive ones at 534 nm, and red-sensitive pigments at 563 nm. In general, mammalian photosensitivity is limited to a narrow electromagnetic wavelength range between ultraviolet and infrared, that is, approximately 380 to 760 nm (Schmidt-Nielsen, 1989).

Vision in Subdued Light

Although the dog's ability to recognize detail and color is limited, dogs possess significant abilities to see under conditions of subdued light or in darkness. Unlike humans, who are phylogenetically adapted to diurnal (daytime) activities, dogs are biologically adapted to a crepuscular rhythm of activity—that is, they are most active around dawn and again at dusk. Selective pressures have resulted in the evolution of structures and mechanisms facilitating vision under subdued light conditions. Night vision is made possible by a photosensitive chemical called rhodopsin contained in the rod receptors. When light energy falls on the rods, the rhodopsin is chemically altered or "bleached" out, transducing a neural signal that is relayed via bipolar cells to the retinal ganglion and, finally, to the optic nerve and brain. When the light source is removed, the photochemical gradually recovers to its original state. Unlike cones, which are linked to individual fibers in the optic nerve, numerous rods are synaptically connected in the retina to the same neural fiber. This "wiring" is a structural feature of canine vision that yields a loss of visual detail but an increase in light and movement sensitivity.

The dog's vision under subdued light is enhanced by a special reflecting surface, called the tapetum lucidum, located behind the retina. Under conditions of low lighting, the pupil dilates, allowing as much light as possible to enter the eye. Unabsorbed light passing over the retina is concentrated on the tapetum and reflected back over the light-sensitive rod receptors, thus causing added bleaching of rhodopsin and a greater sensation of light. The reflective glow of a dog's eyes when exposed to bright light in darkness is caused by the mirrorlike tapetum. Located below the tapetum lucidum in the lower part of the eye is a heavily pigmented tapetal structure called the tapetum nigrum, which is believed to absorb excessive light entering the eye and thereby reduce glare and scatter effects. Whereas the tapetum lucidum is adapted to accommodate light reflected from the darker earth, the tapetum nigrum is adapted to handle brighter light coming from the sky. These two tapetal structures work together to optimize the amount of illumination reaching the retina.

Binocular Vision and Depth Perception

In general, the eyes of predators are set toward the front of the head, giving them a much sharper and wider field of binocular vision than experienced by prey animals. The eyes of prey animals are usually located more toward the side of the head, giving them an ability to scan the surrounding environment widely for approaching danger. Binocular vision depends on a field of ocular overlap between left and right eyes and a network of complex retinal projections involving both sides of the visual cortex. Such visual abilities enable predators to precisely locate, focus, and track a prey's movement. As the result of the placement of the eyes and the presence of a prominent muzzle blocking a full frontal view, the average dog exhibits only approximately 40 to 60 degrees of overlap between

the right and left eyes. This gives dogs binocular capabilities that are good but inferior to human abilities. Such anatomical limitations, however, are a gain in terms of peripheral vision. Whereas human peripheral vision extends to about 180 degrees, the average dog's peripheral range is approximately 250 degrees. Of course, the amount of binocular and peripheral vision varies considerably from breed to breed depending on how the eyes are set in the skull and various neural substrates mediating visual perception.

An important aspect of binocular vision is depth perception. Although a dog's binocular vision is good, a dog's ability to perceive depth is somewhat mitigated by a lack of full binocular vision. Since a dog's binocular vision is limited to a more or less narrow frontal range, a dog's ability to perceive depth is also restricted to a narrow field of vision located directly in front of it. Miller and Murphy (1995) have pointed out, however, that depth perception does not rely on binocular vision alone. Monocular depth perception is also possible as the result of head movements that produce an appearance that objects are moving at different speeds relative to one another, thus providing information about relative distances and depth between them. Other sources of important information concerning depth include foreground/background contrast, atmospheric or aerial perspective (clarity of contour), relative size/scale of objects, linear perspective, overlapping, and vertical location in the field of vision.

Shape and Form Discrimination

Humphrey and Warner (1934) reported an interesting study suggesting that a dog's ability to form clear object images is limited both under close-up conditions and at distances, indicating that dogs may have a very narrow range of effective vision. They reported a study by Karn (1931; Karn and Munn, 1932) in which dogs were trained to discriminate between two triangles, one with its apex pointing up and the other pointing down. These triangles had 9-inch sides, and the dogs were permitted to approach as closely as they liked before choosing between them. Karn found that the dogs usually made choices only after they were within 20 inches of the triangles. By progressively making the triangles smaller, he was able to obtain reliable discrimination between triangles with 3-inch sides but no smaller. Humphrey and Warner note that a parallel deficiency in human vision would result in our not being able to read a book unless it had "letters three inches high."

Karn and Munn's results conflict somewhat with earlier findings by Pavlov's associate, Shenger-Krestovnikova, who experimented with very subtle shape discriminations in dogs (Pavlov, 1927). In one of her experiments, dogs were required to discriminate between a circle and an ellipse. Over the course of several trials, the shape of the ellipse was gradually expanded in the direction of a circular shape. This was accomplished by altering the ratios of the semiaxes of the circle to the ellipse from 3:2, 4:3, 5:4 ... 9:8. She found that dogs could master discriminations as fine as 9:8 but only with great difficulty. A few of the dogs studied developed striking neurotic sequelae as a result of the perceptual and emotional distress caused by the difficult visual discrimination (see Chapter 9). I once participated in a feasibility study involving military scout dogs that required them to perform a number of sophisticated remote tasks. These tasks were shaped through progressive preliminary training that began with a simple pattern discrimination in a Y maze. The cards (checker patterned and blank) were approximately 12 inches square and placed about 15 feet away from the decision point. The dogs showed great difficulty in mastering this simple discrimination task. After several days of frustrated effort, a flashing light stimulus was added to augment the positive card and to facilitate the discrimination required. The difficulty exhibited by the dogs (German shepherds bred at Biosensor Research for trainability and intelligence) may have been related to a perceptual factor similar to the one discovered by Karn—that is, perhaps the choice point was too far away for them to differentiate accurately between the discriminative stimuli being presented.

Despite the dog's apparent difficulty in discriminating stationary shapes and patterns, most dogs unquestionably possess excellent

abilities to discriminate between individuals at distances and in groups—a common and readily demonstrable observation. This ability may be due to an acute sensitivity to movement and subtleties of gesture. Whitney (1961) reported that dogs that had been previously addicted to morphine would copiously salivate whenever they saw him coming toward their kennel. When approached by strangers, the salivation effect was never evident unless he happened to be part of the group. Whitney claims to have observed, through field glasses, addicted dogs salivating as he approached their kennel at variable distances up to 120 feet away. Miller and Murphy (1995) reported a study performed in 1936 with 14 police dogs. In this study, dogs that could identify moving objects at 810 to 900 meters (m) could only recognize these same objects when stationary at much closer distances (585 m or less).

Blindness

Occasionally, dogs lose their sight. Some common causes of blindness or loss of visual acuity include cataracts, progressive retinal atrophy, and glaucoma. Although sight is an extremely important sensory ability for dogs, blindness need not be a cause for euthanasia. Dogs appear to adjust well through compensatory reliance on other senses like hearing and smell and probably with the help of kinesthetic learning of the environment. Chester and Clark (1988) carried out a survey of 50 dog owners with blind dogs. Only 22% of those surveyed noticed a change in their dog's temperament. The most common temperament changes reported were an increase of dependency and attention-seeking behavior. Other changes included increased fearfulness toward family members or other dogs. Of the owners, 74% reported that there was no change in their dog's response to strangers; 12% reported that their dog failed to compensate adequately within familiar surroundings. Only two dogs were reported to experience an increase in aggressiveness—one of which was explained as the result of painful glaucoma and "resentment" about being medicated. This is a somewhat surprising finding, since many behavioral specialists regard blind and deaf dogs as being more prone to develop aggression problems.

To facilitate a blind or vision-impaired dog's adjustment, appropriate training and management efforts must be carried out. Much of what such dogs performed effortlessly in the past may need to be laboriously relearned. Managing to climb up and down stairs, for example, often proves to be a particularly difficult challenge for blind dogs, but, with patient and gentle encouragement, most blind dogs can learn to climb steps without assistance. Blind dogs appear to form a mental map of the house and quickly learn to avoid bumping into things, provided that the owner is careful not to rearrange furniture or leave objects in the dog's path (e.g., kitchen chairs left out from under the table). Such dogs should be fed in the same place and, for added safety, crated when the owner is absent. Also, the owner might wear a bell as an auditory means to communicate his or her whereabouts to the dog (Campbell, 1992). Olfactory cues (e.g., citronella oil) can be dabbed lightly on the corners of doorways, furniture, and other objects that may be bumped into as the dog moves through the house. The strategic placement of gates and other barriers is also useful. As in the case of deaf dogs, training blind dogs is based on the utilization of sensory modalities other than the disabled one, especially hearing and touch. Van der Westhuizen (1990) has recommended teaching dogs to respond to directional cues such as "left" and "right" to help guide their movements. He suggests that heeling lessons are facilitated by allowing the dog to make contact or lean into the handler's leg, thus providing additional means to orient the dog's movement while walking in close quarters. In addition to the use of gentle physical prompts, training blind dogs depends on the use of expressive verbalization, using tonal variations and inflections to promote effective communication. Both blind and, as will be seen in a moment, deaf dogs are at considerable risk of being injured by pedestrians (e.g., bicyclists and skaters) or by vehicular traffic and should be leashed whenever away from home.

Audition

The dog's ear is composed of an outer ear (pinna), auditory canal, and various structures designed to convert sound waves into auditory information. The pinna gathers and directs sound into the auditory canal, where it is carried to the tympanic membrane or eardrum. The eardrum is an extremely sensitive and elastic membrane reacting to the slightest vibrations on its surface: movement of less than one-tenth the diameter of a hydrogen atom can produce an audible sensation (Thompson, 1993). The vibrations caused by the pressure of sound waves on the eardrum are mechanically conducted to the cochlea through the mediation of three tiny bones or ossicles: the malleus, the incus, and the stapes. The cochlea is a snail-like tubular structure that is innervated by the auditory nerve. Sound vibrations are passed into the cochlea at the oval window. These vibrations cause a fluid wave in the cochlear fluid, which causes a rippling effect against the surrounding basilar membrane. The vibratory displacement of the basilar membrane stimulates auditory receptors (called hair cells) to bend rhythmically, thereby evoking a nerve potential that is carried by individual fibers into the auditory nerve. Different sounds are distinguished by the specific pattern of wave motion that they generate. The vibratory wave movements in the cochlear fluid selectively activate certain groups of receptor cells while passing over others as they flow against the surrounding basilar membrane. Audibly different sensations are produced by the distinctive pattern and topography of the wave involved. Auditory sensations are conducted by the auditory nerve to the cochlea nuclei located in the medulla oblongata before being relayed to the thalamus.

Frequency Range of Hearing

The dog's range of hearing has been shown to be superior to human audition in many respects. Dogs can easily hear sounds outside the human range of audibility [20,000 cycles per second (cps)]. Estimates vary from 26,000 cps (Fuller and DuBuis, 1962), 41,000 to 47,000 (Heffner, 1983), 30,000 to 40,000 (Schmidt-Nielsen, 1989), and 60,000 to 65,000 cps (Houpt, 1991); whatever the case may be, dogs do hear ultrasound—sound that is imperceptible to normal human ears. Dogs can also hear sounds of very low frequencies at 15 cps. The general range of hearing estimated by Fox and Bekoff (1975) is 15 to 60,000 cps. To place these numbers into perspective, 28 cps is the frequency of the lowest key on the piano and 4180 cps is the frequency of sound produced by the highest key. Apparently, dogs hear best at around 4000 cps, compared with humans at 1000 to 2000 cps. Lipman and Grassi (1942) compared human hearing with that of dogs and found that under comparable sound intensities (decibels) dogs and humans did about equally well with regard to the perception of low frequencies (125 to 250 cps). They observed, however, that dogs do progressively better as the frequencies increase with "markedly superior" abilities between 4000 and 8000 cps, and concluded that "the dog lives in a broader and deeper acoustic world, thus gaining direct contact with natural events which are imperceptible to man" (1942:88).

Auditory Localization

Another way that the dog's sense of hearing is better than ours is its ability to locate the origin of sounds coming from a distance. A variable ability to localize the origin of sounds is evident in puppies as early as 16 days of age (Ashmead et al., 1986). Adult dogs are able to pinpoint the origin of sound with a great accuracy with the aid of their movable earflaps (pinnas). Locating the origin of sound, however, involves much more than facile movement of the ears. Sound location depends on complex brain calculations that rely on the dog's ability to register narrow time differences between the sound reaching each of its opposing ears. The ear closest to the source of sound is struck slightly sooner than the opposite ear. Determining the direction of the sound's origin depends on a cooperative mediation of information between the cochlear nuclei and

time-sensitive neurons located on either side of the brain stem in a structure known as the superior olive. These neurons can detect delays of stimulation between one ear and the other on the level of microseconds (a millionth of a second). The slightest movement of the head toward the source of stimulation provides additional information about distance. A change in the dog's head position relative to the sound provides spatial information that can then be used by the brain to triangulate and compute the sound's distance (Thompson, 1993). The common tendency for a dog to cock its head to one side when listening carefully to an unusual sound is probably a reflexive effort to pinpoint a more exact location, perhaps involving a dimension of height relative to the ears when positioned parallel to the ground.

Ultrasound and Training

A potential application utilizing the dog's ability to hear in the ultrasonic range is to use high-frequency sounds in dog training. Of course, the Galton or "silent" whistle has been used for many years as a signaling device, especially for recall. Recently, however, many battery-powered ultrasonic devices have come onto the market for use in behavioral training as "humane" forms of punishment for nuisance barking and other behavior problems (Landsberg, 1994). An assumption underlying the use of such devices is that the ultrasound stimulation produced by them is aversive to dogs—that is, that it hurts their ears. This assumption, however, has not been borne out by personal experience or experimental testing. For example, Blackshaw and coworkers (1990) tested the auditory reaction of several dogs, ranging widely in size and breed type, to variable frequencies of ultrasound under controlled conditions. They found that ultrasonic devices producing high-frequency sounds between 14 to 36 kHz resulted in remarkably little apparent aversion in the dogs, mostly yielding a "no effect" response or minimum signs of interest as indicated by brief pricking of the subjects' ears. A few dogs reacted aversively to the sound by turning away from it. Small dogs appeared to be slightly more sensitive to ultrasound than are medium or large dogs. This latter finding is consistent with Galton's early observation that small dogs responded to his silent whistle while large dogs did not. However, this apparent difference between small and large dogs does not appear to depend on the size of the dog's head or auditory apparatus. Heffner (1983) found that the upper limits for high-frequency hearing are remarkably similar from breed to breed, regardless of their size and ear shape: Chihuahua, 47 kHz; dachshund, 41 kHz; poodle, 46 kHz; pointer, 45 kHz; and St. Bernard, 47 kHz. Perhaps smaller dogs are simply more behaviorally reactive to ultrasound than are large breeds.

These devices have not proven to be very reliable, effective, or aversive to most dogs. I have been disappointed by my own experiences with the products, finding them unreliable or ineffective beyond an initial "What's that?" or a mild annoying effect that dogs readily habituate to after a few trials. One popular bark-activated model that I tested actually jammed on a continuous mode and would have continued producing the ultrasound until it "fried" or the batteries ran down. Fortunately, it was not on a dog; unfortunately, the product is still on the market and widely used.

A possible explanation for the relative ineffectiveness of ultrasonic devices may be the result of insufficient power to drive the ultrasonic pulse. In other words, the small battery-powered models may not be strong enough to produce an aversive auditory effect. Ultrasound requires relatively more energy and amplitude than sound generated at lower frequencies. Frequencies above a dog's optimal range of hearing require progressively more amplitude boosting to be heard. For instance, to obtain an orienting response to the sound of a silent whistle, the effort needed to blow the whistle adjusted at a high frequency is much more forceful than required when it is adjusted to a lower one.

Ultrasound has two other distinct characteristics limiting its usefulness: narrow field of directionality and limited effective range. Unless the device is pointed directly at a dog's head at a close range, its effectiveness is drastically diminished. In the case of bark-acti-

vated collars, the ultrasonic burst may be blocked by the dog's neck and jaw, requiring that the sound stimulus reach the dog's ears by way of echoes from surrounding objects rather than from the collar itself. This further mitigates its usefulness in situations where nearby objects are not present, such as outdoors. Lastly, dogs may not be biologically prepared to readily associate ultrasound stimuli (even at high levels of stimulation) with threat without additional aversive conditioning. Ultrasound may possess some innate significance as a directional indicator for detecting and locating small prey animals, whose distress vocalizations are expressed at ultrasonic frequencies.

No adequate learning studies (that I am familiar with) have been carried out that demonstrate the effectiveness of ultrasound as a punisher or negative reinforcer in dogs. Considering the cost of the devices, and the ready availability of consistently more effective alternatives, one should resort to their use only in rare cases of special need, for example, with especially sensitive dogs or where auditory-mediated punishment needs to be silent. Although the use of ultrasound as an auditory punisher is not recommended, low-intensity ultrasound can be usefully employed in dog training as a means for signaling and controlling learned behavior (e.g., the silent whistle). Pairing unobtrusive ultrasonic cues with trained behaviors proves very effective in place of verbal commands in certain situations where silent control is desirable. Unfortunately, ultrasound is currently most often applied as a punitive device rather than a potentially valuable training tool for the delivery of discriminative signals and secondary reinforcement.

An additional problem raised by the dog's sensitivity to ultrasound is the advisability of ultrasonic flea deterrents. Ultrasonic collars are frequently used by pet owners to control flea infestation. This is unfortunate, both because they do not work (Dryden et al., 1989) and because the sounds produced by such devices are audible to dogs and cats exposed to them (Roe and Sales, 1992). Obviously, the possibility exists that ultrasonic flea collars may produce significant annoyance to dogs with sensitive hearing abilities. Ultrasonic flea collars produce frequencies well within the range of a dog's hearing capability, at approximately 40,000 cps (92 dB amplitude at a distance of 10 cm). A serious question must be raised regarding the impact of daily exposure to pulsing ultrasound stimulation at these levels to a dog's quality of life. This is especially pressing since ultrasonic collars have been proven uniformly ineffective against flea infestation. While the directionality of ultrasound at the aforementioned frequencies probably prevents it from directly reaching the dog's ears while wearing the device, it does not prevent echoes from reaching the dog's ears indirectly or prevent the ultrasound from reaching resident dogs or cats exposed to its unobstructed output.

Deafness

Deafness occurs in dogs as a congenital disorder or may be acquired as the result of disease or physical damage to the auditory mechanism. Congenital deafness appears to be linked to pigmentation, with the likelihood of deafness increasing with the amount of white pigmentation present in the dog, especially in dogs that exhibit an absence of normal iris pigmentation. The merle gene (e.g., the Australian shepherd, Harlequin Great Dane, Old English sheepdog, and others) and piebald gene (e.g., bullterrier, Dalmatian, Great Pyrenees, and others) have been associated with an increased incidence of deafness (Strain, 1996). Dalmatians commonly exhibit congenital deafness, with as many as 30% of the puppies born exhibiting the disorder in one or both ears. Temporary hearing loss (elevated thresholds) may result from exposure to intense auditory stimulation exceeding 100 dB. For example, hunting dogs exposed to repeated close-range gunfire may experience significant noise-related hearing loss.

Determining whether a dog is deaf is best accomplished by the brain stem auditory evoked response (BAER) test, which detects electrical activity in the cochlea and other auditory nervous pathways in the brain. The test is conducted by directing a brief auditory stimulus (a click) into both ears and measuring the evoked electrical patterns produced by the stimulation. Deaf dogs will present a

flat-line appearance. A major advantage of the BAER test is that it can isolate deafness in one ear (unilateral) or both (bilateral) ears (Strain, 1996). Bilateral deafness can also be detected by the absence of an appropriate response to loud startling noises or a failure to acquire various conditioned associations that depend on hearing to learn (e.g., the dog's name and other verbal/auditory cues used in training).

According to the reports of many deaf dog owners (Becker, 1997), deaf dogs can make a good adjustment to domestic life. Success with such dogs depends on careful training and other management efforts needed to protect the hearing-impaired dogs from injuries that might be sustained as the result of their inability to hear, especially the threat of vehicular injury. Like blind dogs, deaf dogs learn to rely on other sensory modalities to obtain environmental information, including vision, touch, and olfaction. Consequently, deaf dogs can be taught to respond to a wide variety of visual cues and hand signals, as well as various common forms of tactile stimulation used routinely in dog training. Obviously, training a deaf dog poses many unique problems, such as securing and maintaining the dog's attention, especially when the handler is out of the dog's field of vision. Campbell (1992) recommends the use of beanbags to condition dogs to keep their attention on the handler. When a dog's attention wavers, the beanbag is tossed at the dog's legs. The handler then turns and walks in an opposite direction while encouraging the dog to follow along. As the dog approaches, the handler crouches down and reinforces the following behavior with petting. Other ways to hold a deaf dog's attention include consistently reinforcing attention with treats, tossing toys into the dog's field of vision, stomping on the floor, and using flashlights and lasers (Becker, 1997). Remote-activated electronic collars are sometimes used for the control of undesirable behavior and to train dogs to come. A rather unique application of such devices set at a very low level is to pair the mild stimulation produced by the collar with food and other rewards. As a consequence, the stimulation can then be used to reinforce desirable behaviors conditionally in much the same manner as applying other common conditioned reinforcers (e.g., "Good"). Remote-activated vibratory devices are also used for such purposes. Finally, even though dogs cannot hear, Tanner has emphasized that trainers should still speak to dogs as though the dogs can hear, since "we transmit our feelings and desires to our dogs through facial expressions as well as oral commands" (1970:23).

Deaf puppies are routinely euthanized, in part, as the result of the widespread belief that congenital bilateral deafness represents a significant risk factor for the development of a variety of behavior problems, including aggression—presumably developing as the result of repeated and unpredictable startle. The linkage between deafness and aggression is a highly controversial topic, with little current evidence available other than anecdotal reports and clinical impressions supporting the assumption that deaf dogs are more prone to bite. What most authorities do agree on is that deaf dogs require considerably more focused care and training than hearing dogs—a factor that the prospective owner of a deaf dog should realistically assess before making the decision to adopt.

Olfaction

The dog's sense of smell has attracted a great deal of enthusiastic attention from both applied and scientific quarters but has only slowly received appropriate experimental study. Historically, almost supernatural capabilities were attributed to a dog's nose, often resulting in the promulgation of some rather fantastic and insupportable claims about canine olfactory abilities. In addition, many equally incredible theories have been posited regarding the way in which a dog's olfactory apparatus works (McCartney, 1968). These theories have ranged from the absurd to the occult. For example, one fanciful account hypothesized that irradiated energy emanating from living cells was absorbed by various materials stepped upon, and then re-emitted and detected by the dog's nose. Other discarded theories posited the notion that electrical waves or vibrations were responsible for the extraordinary feats of canine olfaction. One speculative adherent of the wave theory actu-

ally proposed that a pendulum be employed as an instrument for measuring the dog's olfactory acuity. Over the years, many important advances have been made in the study of olfaction, largely supplanting theories like the foregoing with more scientifically grounded alternatives. Currently, the science of smell is making important strides toward a more complete understanding of the intricate biochemical and neurological substrates of olfaction.

Mechanics of Smell

The sense of smell enables dogs to analyze the environment for significant chemical signs or disturbances. During the process of smelling, a sample of air containing the odor is sniffed and directed deep into the posterior portion of the left and right nasal cavities. Once in the nasal cavity, the odor accumulates on a mucous layer containing millions of odor-sensitive cilia. The cilia are hairlike dendritic elaborations of the olfactory receptor neuron. Each olfactory receptor has 10 or more immotile cilia that collect odorant molecules. The convoluted epithelial membrane containing these olfactory receptors is supported by a complex structure of turbinate bones. This arrangement allows for maximal contact between the collected odor and the olfactory mucosa. In addition, the cilia themselves add considerably to the overall membrane surface area exposed to odorant molecules. A dog's olfactory neuroepithelium contains as many as 250 million receptor cells. When stretched out, the surface area of the olfactory epithelium has been estimated to range (depending on the breed) from 20 to 200 square centimeters. In comparison, the human olfactory neuroepithelium covers a mere 2 to 4 square centimeters and contains only about 5 million receptor cells per nasal cavity (Cain, 1988).

Olfactory Transduction

Sensory data from these millions of receptor cells is conducted through the cribriform plate into the nearby olfactory bulbs within the cranium. Once in the olfactory bulbs, the axons converge upon the glomeruli. The glomeruli are spherical structures that integrate and organize olfactory input. There are far fewer glomeruli than olfactory receptor axons, requiring that many thousands of axons share individual glomeruli. Within each glomerulus, olfactory axons form synapses with second-order olfactory neurons called mitral cells. From the glomeruli, the information is passed onto other parts of the brain for higher processing, associative identification, and interpretation (see Chapter 3). As one might expect, the olfactory bulbs in dogs are considerably larger than those in humans.

The manner in which olfaction occurs is not fully understood, but important advances in the study of olfactory reception have been made by Axel and his associates at Columbia University (Axel, 1995). By using molecular genetics and sophisticated biochemical procedures, they have been able to isolate a large gene family dedicated to the synthesis of olfactory receptor proteins (Buck and Axel, 1991). The researchers have found that the olfactory neuroepithelium contains neurons possessing about 1000 different receptors, coded by an incredible 1% of the mammalian genome. In rats, one in every 100 genes is involved in the reception of odors, making olfactory receptor genes the largest family of genes currently known to exist. Each receptor protein is highly selective and will bind only to a select group of odorants. In combination, these diverse receptors yield an extraordinary diversity of smells. Whereas humans are believed to discriminate around 10,000 separate odors, dogs are probably able to detect a far larger number. These findings are extraordinary when one considers a comparison with all of the rich diversity of human color vision that is provided by only three kinds of photoreceptors differentially sensitive to three overlapping bands of visible light. Given that 1000 different olfactory receptors appear to exist, the potential number of smells available to the mammalian nose is staggering.

Each olfactory neuron expresses a receptor specialized for the detection of a specific type of odor molecule. All of these many receptor proteins are coupled to G proteins concentrated on the distal portion of the cilia. The receptor protein in conjunction with the G

protein activates a cascade of biochemical events mediated by a second messenger within the cell, resulting in the depolarization of the olfactory neuron and the production of an action potential or signal. These olfactory receptor neurons are distributed randomly in several specialized zones on the olfactory epithelium (Ressler et al., 1993). The axons of olfactory neurons with the same receptor converge on the same glomeruli in the olfactory bulb (Axel, 1995). This is an extraordinary finding, since these receptor neurons are destroyed and shed after a functional life of 6 to 8 weeks. Olfactory neurons are being constantly replaced by underlying stem cells that subsequently send axons to the same locality in the olfactory bulb. How this is accomplished is not known.

Olfactory Acuity

Numerous studies have demonstrated that a dog's sense of smell is extremely sensitive. W. Neuhaus (McCartney, 1968; Passe and Walker, 1985) employed an olfactometer for mixing and delivering odorant samples at very low concentrations. His method involved evaporating the sample into a controlled airstream and directing it out through three separate ports, two of which contained air without any odorant. The dog was trained to choose between the three by pressing its nose against a box located behind the port associated with the sample. The concentration of the odorant sample was progressively lowered until the dog could no longer select the correct port. Surprisingly, he found that some substances were not detected by dogs at concentrations much lower than that detectable by humans. In most instances, however, the dog's ability was much superior. For example, he estimated that a dog's ability to detect butyric acid (a component in sweat that smells like dirty socks) is from 1 million to 100 million times better than a human's ability. These results (if true) mean that dogs may be able to detect 1 milligram of butyric acid in 100 million cubic meters of air. Pearsall and Verbruggen illustrate the extent of these incredible findings with a striking analogy:

> Comparison with our own nose is difficult, but an example may help: One of the substances released by human perspiration is butyric acid. If one gram of this chemical (a small drop in the bottom of a teaspoon) were to be spread throughout a ten-story building, a person could smell it at the window only at the moment of release. If this same amount were spread over the entire city of Philadelphia, a dog could smell it anywhere, even up to altitude of 300 feet. (1982:5)

Butyric acid is a prominent feature of the scent picture utilized by dogs while tracking. Wright makes a number of probing observations and calculations based on assumptions drawn from Neuhaus's findings and the abilities of tracker dogs:

> There are several sources of skin secretions: sweat glands, "odour glands", fat glands, and various others. The sole of the foot has only sweat glands, but they are present in large numbers: up to 1000 per square centimetre. Therefore the sweat glands are likely to be the most important. Over a period of 24 hours, the human body secretes about 800 c.c. of sweat, and from the two million or so sweat glands on the sole of each foot, about 2 per cent of the daily production, or about 16 c.c., would be released. Human sweat has about 0.156 per cent acid of which about one-quarter is aliphatic. If only 1/1000 of this penetrates steadily through the sole and the seams of the shoe, it can be calculated that of an acid such as butyric acid, at least 2.5×10^{11} molecules would be left behind in each footprint. This is well over a million times the threshold amount for the dog, and could still give a detectable smell when dispersed in 28 cubic meters of air. (1964:76)

These numbers are staggering, especially if one considers that some bloodhounds can follow trails several days old over rough terrain and then pick out the tracked person from a lineup of 10 people (Sommerville and Green, 1989).

Ashton and colleagues (1957) also found that a dog's ability to detect various odorants was not equally proficient for all sample substances. An apparent factor is related to the size of the molecule involved. Fatty acids differing by only a single atom of carbon re-

sulted in significantly different olfactory thresholds. The more carbon atoms the molecule possessed, the lower was the dog's olfactory threshold for its detection. A possible explanation for this finding is that organic molecules with long carbon chains possibly trigger action potentials in a correspondingly greater number of olfactory receptor neurons than do molecules composed of fewer carbon atoms. The lower thresholds may be obtained because more receptor neurons are fired by molecules possessing a greater number of carbon atoms than those possessing only a few.

More recent and carefully controlled studies have compared the dog's olfactory ability with that of humans. These experiments have found somewhat less dramatic differences between humans and dogs—at least with respect to the substances investigated. Krestel and colleagues (1984) compared the dog's ability to detect amyl acetate with that of human subjects. Using a conditioned suppression technique, they determined that dogs can detect the substance at a concentration 2.6 log units lower (i.e., about 400 times better) than human test subjects. Marshall and Moulton (1981) determined that dogs could detect alpha-ionone at concentrations 3 to 4 log units lower than that detectable by humans (i.e., approximately 1000 to 10,000 times better).

Certainly not all dogs possess such incredible olfactory sensitivity. To obtain a general indication of the dog's olfactory sensitivity, Myers (1991) developed a home test for evaluating a dog's sense of smell. Eugenol, a pure olfactory stimulant, is used in a series of progressively dilute solutions and is systematically presented to a dog. The dog's reaction to each sample is noted. The odorant evokes a range of unconditioned reactions in dogs, including moving the head, licking the nose, or sniffing. This method of evaluating olfactory function has at least two potential shortcomings. First, the dog's reaction to the substance must be interpreted by the owner, who may or may not evaluate its reaction correctly. Secondly, the owner may inadvertently (unconsciously) provide the dog with cues to help it perform better. These problems suggest that the method is best suited for determining gross functions rather than subtle olfactory thresholds.

Biological and Social Functions of Smell

Besides the obvious usefulness of an acute sense of smell for the detection of prey animals, many social functions are coordinated by olfaction. Most dogs engage in scent marking and scent-mark investigation. Dunbar and Carmichael (1981) studied the urinary elimination patterns of laboratory beagles, finding that male dogs spend significantly more time investigating and marking samples of urine belonging to strange males than samples belonging to themselves or other males with whom they are familiar. Their study suggests that dogs are not responding to the smell of urine per se but to some specific pheromonal identifier within the context of urine that excites interest and triggers a marking response. Supporting the view that an olfactory signal triggers the marking response, Shafik (1994) has demonstrated in dogs an olfactory micturition reflex between the nasal mucosa and the urethral sphincters. Electrostimulation of the nasal mucosa appears to relax urethral sphincter muscles in dogs. The author speculates that this reflex induces elimination in the absence of a full bladder, thus contributing to the tendency of dogs to eliminate repeatedly in response to specific odorants rather than in response to signals from pressure receptors in the bladder wall. Other studies have shown that the frequency of sniffing and urinary marking is significantly reduced in animals that have been castrated or rendered anosmic. Among rats, testosterone has been proven to play a significant role as a hormonal enhancer of olfactory acuity (Pietras and Moulton, 1974). Perhaps the decline of sniffing and marking in castrated males is due to relevant pheromones failing to reach thresholds detectable by altered dogs.

Defecation may also serve some olfactory-signaling purpose, although few dogs examine the fecal droppings of conspecifics with

the same degree of interest that they exhibit toward urinary scent marks. Some coprophagic dogs may be very interested in the feces of other dogs, but not apparently for the signaling value of the excrement, but rather for its potential nutritional content. The anal glands secrete a strong-smelling substance into the fecal bolus just before it is excreted. The function of these anal secretions is not known, although dogs will copiously and violently express them when aroused with intense fear. Perhaps anal fluids contain chemical signals that dogs use alone or in conjunction with other chemosensory and physical cues to express or communicate some, as yet unknown, psychosocial intention or meaning. Among wolves, the alphas are most likely to deposit anal gland secretions into their feces and to concentrate their depositions in one area (Asa et al., 1985). Houpt (1991) has speculated that dogs scratch the ground after defecating in order to spread the fecal scent around, but this is an unlikely explanation for such behavior. Most dogs rarely (if ever) disturb their excrement (or urine marks) as the result of such scratching activity. Peters and Mech (1975) observed that wolves actually step away from deposited scats and urine marks before scratching. Some species do scatter their feces around after elimination (e.g., the hippopotamus), ostensibly to mark or maintain territory, but dogs do not engage in this sort of ritual. Two potentially significant outcomes of scratching after eliminating is the deposition of identifying pheromonal scents from the paws, augmented by impressive (perhaps, even provocative) visual signs of general size, weight, and vigor impressed into the earth with claws like a signature. This latter observation is consistent with the finding that only high-ranking wolves scratch after eliminating.

The sense of smell aids dogs in identifying the sexual status and receptivity of potential mates (Beach et al., 1983). Females begin depositing pheromonal clues about their pending status long before they are actually prepared to accept the males' advances. Such advanced invitation is widely advertised through increased urine marking on the female's part. Upon detecting this evidence of incipient estrus on their excursions, male dogs may become highly aroused and motivated by the female's sexual status but will be roundly rejected if they locate her. Desmond Morris speculates that the reason for these mixed signals is simple—the female secretes these early olfactory signals (pheromones) to maximize the probability of finding a mate:

> This may seem like a pointless period of teasing the male. If she will not accept him, why send out all those appealing scent signals? The answer is that it is important for her to ensure that all potential mates are well aware of her condition, so that when the crucial moment comes she will not find herself mateless. Ovulation occurs spontaneously on the second day of the estrus period proper. A day or two after that the bitch is ready to be fertilized. If males are absent then she will have to wait another six months for her next chance. (1986:92–93)

The dog is highly attracted to the vaginal secretions of the estrous female, which he persistently licks, hounding her until at last she consents to his courtship efforts.

Another important function of olfaction is kinship recognition. Hepper observed that puppies recognize littermates and prefer contact with them over nonlittermates, and he speculated that some combination of olfactory and visual information mediates such kin recognition and contact preference: "Pups oriented to the cage by visual cues and then used olfactory cues for 'close-up' recognition" (1986:289). Mekosh-Rosenbaum and coworkers (1994) demonstrated that puppies do use olfactory cues to identify littermates. Puppies at various ages were exposed to the bedding of both kin and nonkin conspecifics. Young puppies (20 to 24 days old) spent significantly more time investigating and making contact with kin bedding than with nonkin bedding. After 31 days of age, however, puppies began spending approximately equal time investigating kin and nonkin bedding. Interestingly, between days 52 and 56, male puppies were significantly more attracted to nonkin bedding. They speculate that this shift coincides with a "weakening of the mother-litter bond, leading toward the pups' ultimate independence" (1994:498).

This change coincides with the optimum time for placing a puppy in its permanent human home at around 7 weeks of age.

The canid habit of rubbing on strong-smelling substances is as common as it is intriguing. The habit appears in puppies as young as 3 months of age. Dogs scented in such a manner are immensely interesting to other dogs, attracting the active attention of conspecifics with whom they happen to come into contact. To the chagrin of the owner, the behavior is often exhibited immediately following a bath. The most commonly posited theory for the habit is olfactory camouflage. By rubbing in the strongest ambient smell, a predator might enjoy some slight advantage while stalking its prey. Although this theory seems plausible enough, it has been rejected by some authorities, based on the hunting techniques of the wolf. A second theory suggests that the habit provides a kind of scent identity shared by the pack—with any strong odor being a sufficient stimulus to excite socially infectious and ecstatic rubbing—regardless of the source. Captive wolves have been observed rubbing in the same scented spot until the whole pack is scented with the odor (E. Klinghammer, personal communication). While the object of such behavior is typically carrion or dung, any strongly odiferous substance will attract the response from wolves—even expensive perfume! (Mech, 1970). Fox has suggested that dogs may be motivated by "an aesthetic appreciation of odors" (1972:222) or, perhaps, such behavior may serve to enhance social recognition and contact (1971a). Kleiman (1966) suggested that the typical physical movement associated with the pattern is intended to impart the animal's scent to the object rubbed upon—not necessarily to receive odor from it. Morris (1986) rejected this suggestion, arguing that if the canid's intention was to mask the odor it would deposit an equally intense smell (feces or urine)—not simply rub on it. He speculated that a possible purpose for the habit is to obtain and share information about the surrounding environment with other pack members via various scents the scouting wolf has rolled upon. Although pack members show great interest in the returning scout and appear to delight in the smells that he has collected, whether this exchange ever results in the initiation of a hunting sortie has not been determined. To my knowledge, there has not been a controlled scientific investigation of this interesting phenomenon.

Ability to Detect and Discriminate Human Odors

Besides playing an important role in the social identification of conspecifics, the sense of smell is also used by dogs to identify people. Furthermore, the manner in which dogs smell and where they smell may be significant. Millot and colleagues (1987) reported that during spontaneous interaction between dogs and children, dogs more commonly sniffed the face during appeasing and friendly interaction, directed smelling to arms and legs during competitive encounters, and directed olfactory interest to the child's chest and legs when he or she was not behaving in any special way toward the dog. Smell may give observant dogs many clues about the emotional status of their owner or guest. Dogs appear to react differentially to the smells of people according to their emotional states and health. Owners have frequently commented on such abilities being exhibited by their dogs. Reportedly, Montaguer (LeGuerer, 1994) has found that dogs exhibit a repulsion toward the odor of psychotic children. According to LeGuerer, Montaguer performed a series of experiments with child-like dummies, with one dummy wearing undergarments saturated with the smell of a psychotic child while the other one wore undergarments imbued with the odor of a normal child. The dog actively avoided coming into contact with the dummy wearing underwear having the odor of the psychotic child.

Edney, who has studied a group of dogs believed to possess the ability to anticipate epileptic seizures in their owners, has speculated that affected dogs may be responding to "distinctive odors generated in the aura phase of epilepsy" (1993:337). Strong and associates (1999) have recently confirmed that *seizure-alert* dogs can be specifically trained to

detect signs of impending seizure. The dogs included in the study were able to warn their owners of impending seizure from 15 to 45 minutes prior to the seizure's onset. An apparent beneficial by-product of such dogs was a significant reduction of seizure activity in their owners. Another interesting area involves dogs belonging to diabetics. Lim and colleagues (1992) found 15 cases in which some dogs appear to detect and react to hypoglycemic episodes in their owners. In another study, Smith and Sines (1960) found that rats could be trained to discriminate reliably between sweat samples taken from schizophrenics and sweat samples taken from nonschizophrenic controls. Perhaps, in the future, dogs will serve chemosensory diagnostic functions as yet not fully exposed—for example, the early detection of various mental and physical disease conditions. In addition, a dog's nose might be usefully employed for the detection of environmental pollutants at concentrations below the threshold of currently available mechanical means.

The dog's ability to detect and identify human scent is extraordinary. For example, King and coworkers (1964) found that dogs could detect the presence of a single fingerprint placed on a glass slide that was up to 6 weeks old (indoor samples). In their experiment, each discrimination trial involved four blank slides and one fingerprinted slide. Correct choices required that the dog sit in front of the fingerprinted slide. They compared the dogs' accuracy of detection along two separate dimensions of scent viability: age of scent and the effect of outdoor weathering. Toward this end, some of the slides were carefully preserved indoors while others were exposed to outdoor conditions for varying lengths of time before testing began. The dogs could easily detect indoor fingerprint samples after 3 weeks but were successful only 50% of the time after 6 weeks. They failed to detect outdoor samples reliably after 2 to 3 weeks. Fingerprints on slides covered by a film of water could not be detected.

Kalmus (1955) evaluated the dog's ability to discriminate between the scent of different people, including family members and twins. He demonstrated that dogs could easily and reliably make such discriminations, even between family members—unless they happened to be identical twins. He used freshly laundered handkerchiefs that had been scented from the armpits by the test subjects. The dogs were trained to sniff the hand of the subject and then to select the handkerchief that had been handled by that person. In the case of identical twins, the dogs appeared to treat the handkerchiefs scented by them as identical. This outcome suggests that the *preferred* scent cues were not incidental olfactory stimuli like clothing, diet, or emotional states. The really interesting result of Kalmus's study, however, occurred during tracking tests. On the whole, dogs that were given the scent of one twin would readily follow the other, *unless* both twins laid the track side by side and then split off in opposite directions. Under such conditions, one of the dogs studied consistently tracked the twin who had actually provided the sample scent, suggesting that under certain conditions dogs might rely on other *secondary* olfactory markers (perhaps incidental and transient) to differentiate the human scent.

A more recent study by Hepper (1988) found that both genetic and environmental factors affect a dog's ability to discriminate between twins. The experiments used a matching-to-sample method. Twins were instructed to wear two T-shirts over a 48-hour period. The dog was presented with one of the T-shirts to sample for several seconds. Meanwhile, the matching T-shirt along with the other twin's T-shirt had been crumpled and placed into a small plastic trough standing 10 feet away from the dog and handler. The dog was sent to retrieve one of the two T-shirts. Hepper found that dogs could accurately discriminate between twins so long as they differed in one of two directions: genetic relatedness or environment factors (e.g., diet). The dogs were unable to discriminate between infant identical twins if they had been fed the same diet.

A few years ago, Brisbin and Austad (1991, 1993) evoked a controversy by suggesting that dogs could not reliably match scents collected from different parts of the body to the correct human donor, thus contradicting Kalmus's previous finding that scent samples taken from the armpit could be

accurately matched with scents taken from the hand. Their study aimed at determining the extent to which dogs could generalize scent discrimination training and matching abilities to scents collected from different parts of the body. The study was limited to three dogs—all previously trained to discriminate scent articles (AKC Utility Test) from scent collected from the hands only. None of the dogs had any previous experience involving the discrimination of scent from other parts of the body or law-enforcement experience. The researchers found that when the dogs were prompted to discriminate the scent sample taken from their owner's elbow from the scent samples collected from the hands of a stranger, they were only successful 57.9% of the time (results not rising above statistical chance).

In reply to Brisbin and Austad, Sommerville and colleagues (1993) criticized their study, arguing that the resulting findings suffered from an inherent ambiguity stemming from the way in which the dogs were trained and tested. For one thing, the dogs involved were trained to discriminate only scent collected from the hands and were naive with regard to the discrimination of scents obtained from other parts of the body. Ostensibly, the dogs had learned the scent signature of hands but not a reliable specifying signature of a person's identity per se. According to Sommerville and associates, the results reported by Brisbin and Austad were inconclusive, measuring an artifact resulting from inadequate preparatory training rather than a lack of ability to generalize or match scent accurately. The researchers subsequently carried out a much more extensive study of their own to test this general hypothesis (Settle et al., 1994). In contrast to the negative findings of Brisbin and Austad, they demonstrated that, if properly selected and trained, dogs can reliably discriminate and match body scents collected from different parts of the body to the correct donor:

> Our results show that dogs can efficiently match objects bearing the scents of individual humans whom they do not know even when the scented objects have been in contact with different parts of the body and collected with no particular precautions to avoid environmental contamination. ... Our results suggest that if dogs are selected well, sympathetically trained and entirely dedicated to scent discrimination in a well-managed unit they are likely to maintain a dependably high performance over long periods. (1994:1446–1448)

The significance of the Brisbin-Sommerville controversy is to underscore the importance of careful selection, extensive training, and testing/certification of dogs used by law enforcement for tracking and identifying suspects.

Localizing the Origin and Direction of Odors

The primary function of olfaction in dogs is to detect and locate odors emanating from the surrounding environment. Von Bekesy (1964) performed a series of experiments to determine whether olfactory localization occurred in a manner analogous to directional hearing. He discovered that in the process of sniffing there exists a small time delay between the odorant entering one nostril before reaching the other, unless the source of the odorant is located directly in front. A difference of as little as 0.3 millisecond between nostrils was found sufficient to calculate the odorant's general direction of origin. He also found that differential olfactory analysis of the relative concentration of the left sample as compared with the right one provided additional information about the odorant's location. From this information, a gradient is formed from which a dog can calculate the approximate direction of the origin of the odorant by the differences of concentration entering the respective nostrils.

Schwenk (1994), who has studied the chemosensory locating abilities of snakes, has shown that a snake's tongue serves a similar direction-finding function as that performed by the separated nostrils of mammals. Scent gathered by one fork of a snake's flicking tongue is slightly more or less concentrated than scent gathered by the other. By comparing these differences via the vomeronasal organ (VNO), a snake is able to trail and locate prey animals wounded with venom. If the forked portion of the tongue is severed, a snake is unable to trail. Further, if one side of

the VNO is blocked, a snake tends to trail in the direction of the unblocked side, consequently moving about in a wide circular path.

Few trails in nature are found at their source but are crossed and detected at some arbitrary point along their length. Determining which way to go once a trail is located is a challenge to the olfactory abilities of predators. This is also a problem of considerable importance for dogs trained to track people. McCartney (1968) discussed early directional tracking experiments carried out by Belleville, a Berlin police officer, who found that trained tracker dogs, when led to the midpoint of a track and started at right angles to it, chose the correct direction in only 47% of the trials. He concluded that the correct determination of track direction by the dogs was probably based on little more than chance. Other disappointing reports confirmed that the directional choice appeared to be based on statistical chance (Morrison, 1980; Schwartz, 1980). Similar results were found by MacKenzie and Schultz (1987), who tested 22 dogs trained to track but not trained to determine the direction of the track. Although six of the dogs exhibited perfect scores, the overall statistical picture for the group of dogs as a whole was not much better than random chance.

In contrast to these earlier difficulties with directional tracking, Steen and Wilsson (1990) found that professional tracker dogs can reliably choose the right direction on the basis of olfactory information alone. The researchers laid 50-m tracks on grass and on an asphalt airstrip. After 20 to 30 minutes, the dogs were brought to the track, faced in a perpendicular direction relative to the track, and unleashed. The dogs reliably determined the correct direction of the track.

Thessen and colleagues (1993) have confirmed the earlier findings of Steen and Wilsson with dogs previously trained for directional tracking. They tested German shepherd tracking dogs on fresh tracks 20 minutes old on grass and 3 minutes old on concrete (10 trials per dog on each surface). The dogs were equipped with a remote microphone and transmitter that recorded sniffing sounds. Other movements were recorded by a video recorder. The researchers found that directional tracking involves three distinct phases. (1) A searching phase during which the dogs moved and sniffed rapidly. The dogs sniffed at a rate of approximately 6 times per second during all phases. (2) A deciding phase characterized by slower movements and longer sniffing periods and with the dog's nose placed closer to the ground. The deciding phase lasted 3 to 5 seconds and involved the dogs sniffing at two to five footprints before choosing a direction. (3) A tracking phase involved more active movement and sniffing, similar to those observed during the searching phase.

Steen and Wilsson (1990) have hypothesized that a dog's ability to determine the direction of the track depends on a comparison of olfactory concentrations emanating from consecutive steps, thereby forming an olfactory intensity gradient. If this is true, it empirically confirms the incredible power of the dog's nose:

> If we assume that each footprint smelled the same at the moment it was set, and that the scent evaporated at a constant rate, we can get an idea of the dogs' sense of smell. We walked at a rate of one step per second and tracks were 30 min (1800 s) old when the dogs were tested. The smell from one print should therefore theoretically be 1/1800 stronger than that of the foregoing. This indicates that the dogs were highly sensitive to an odour difference of this magnitude. (Steen and Wilsson, 1990:534)

As extraordinary as these numbers seem at first glance, most trails in nature are far older and demand even greater sensitivity for determining their directionality than required by the experimental arrangements producing the above estimates.

William Carr and associates (Blade et al., 1996; Miller et al., 1996) at Beaver College (Glenside, PA) have studied various factors believed to influence the acquisition of directional tracking. Of particular interest is testing the intensity-gradient hypothesis proposed by Steen and Wilsson. The intensity-gradient hypothesis presumes that dogs can detect a difference of polarity/intensity existing between successive steps made by a track layer, possibly because the scent associated

with the preceding step has undergone perceptible diminishment relative to the scent adhering to the succeeding step. To test this hypothesis, they have performed a number of directional tracking experiments comparing the dog's performance on normal and polarity-enhanced tracks.

In one experiment, two previously trained dogs were tested (Blade et al., 1996). One of them was tested on a normal track laid at a rate of 1 step per second. The second dog received identical testing but on a polarity-enhanced track laid at a rate of 1 step per 10 seconds. This was accomplished by the track layer resting upon a walker and holding the trailing step up for 10 seconds before stepping down again. The operative assumption here is that an increased delay between successive steps would make it easier for dogs to detect differences between them, perhaps as the result of scent dissipation or some unknown qualitative change in the scent picture. As expected from previous experiments, the first dog responded correctly on 14 of 20 trials, whereas the second dog, working on the polarity-enhanced track, responded correctly in 17 of 20 trials—a 21% improvement over this dog's previous score on a normal 1 step/second track. In another experiment (Miller et al., 1996), the interval between critical steps at the choice point was increased to 80 seconds between steps. This arrangement resulted in correct directional choices in 80% to 90% of trials. These experiments appear to confirm the earlier findings of Steen and Wilsson regarding a trained dog's ability to determine the direction of track above chance levels of significance, as well as provide significant evidence supporting the intensity-gradient theory of directional tracking.

Vomeronasal Organ

The vomeronasal organ (VNO) is a specialized sensory apparatus located in the anterior portion of the palate, with ducts opening into the mouth just behind the front teeth. The organ is an elongated pouchlike structure that is lined with olfactory receptor cells. These cells are similar to those found in the olfactory mucosa except that they use microvilli instead of cilia. Scent information received by these receptor cells is projected via the accessory olfactory bulb (AOB) directly into the limbic system (amygdala and medial hypothalamus). Although there is some overlap between the olfactory system and the VNO, the latter is particularly well suited for the detection of pheromone molecules of a higher weight than reliably detected by olfaction (Cain, 1988). This difference makes the VNO more sensitive for the detection of nonvolatile chemical messages deposited in the urine and other bodily secretions. An important function of the VNO is the detection and subcortical analysis of these sexual pheromones. Destruction of the VNO results in the loss of normal sexual activities and several other vital functions (e.g., maternal care, aggressiveness, and secretion of sex hormones) in many mammals.

Although dogs do not exhibit the "lip curl" flehmen response observed in other mammals, many dogs do exhibit an analogous response called *tonguing*. When tonguing, the dog's tongue is pushed rapidly against the roof of the mouth, with the teeth sometimes chattering and expressing profuse foam sometimes collecting on the upper lip. Tonguing is frequently observed after a dog licks a urine spot or "tastes the air," following the exchange of mutual threat displays between two rival males. As the antagonists separate, one or the other may project his nose upward and initiate rhythmic sniffing and tonguing movements. The tonguing dog may actually extrude his tongue slightly in an effort to collect a sample. There is often a wide retraction of the lips together with a slight elevation of the muzzle. This action is accompanied by several brief sniffs and wide searching side-to-side movements of the head.

Eccles (1982) showed that the VNO in cats is regulated by the autonomic nervous system. He studied the flehmen response in cats, discovering that the vomeronasal pouch or lumen suctions or expels depending on current sympathetic or parasympathetic stimulation. Under parasympathetic tone, the organ is constantly flushing and developing droplets around vomeronasal ducts. These droplets absorb airborne odorant or tastant samples that are then conducted via a sympa-

thetic-induced pumping action into the lumen of the organ. After the odorant/tastant is sampled, it is expelled with a vigorous flushing action, thus clearing the organ and preparing it for another sample.

Whether dogs exhibit a true flehmen response remains controversial, with many authorities believing that dogs do not display the pattern (Bradshaw and Nott, 1995), although some canid species (e.g., the coyote, side-striped jackal, and bushdog) do appear to exhibit a flehmen response (Ewer, 1973). Overall (1997) suggested that the vomeronasal complex lacks functionality altogether, noting that the vomeronasal sacs are without chemoreceptors. This is clearly not the case, though, according to Adams and Wiekamp, who identified several types of receptors in the vomeronasal epithelium and concluded that the canine VNO is "highly developed and unique amongst that of adult mammals" (1984:781). In addition, Salazar and coworkers (1992, 1994) described vomeronasal nerves and traced their destination to glomeruli in the accessory olfactory bulb. Although the VNO system may be less well developed in dogs than in some other animals (e.g., rats and cats), it is a functional organ of some importance to dogs. Unfortunately, the significance of VNO information for dogs is not known, but it likely serves some functional role in the exchange of pheromone information about social status and the animal's reproductive state.

Some preliminary evidence supporting a sexual function for the VNO system has been found in the study of the wolf's response to methyl *p*-hydroxybenzoate, a sexual pheromone. Klinghammer (unpublished data, personal communication) has discovered an intriguing phenomenon involving this pheromone among wolves. During the breeding season, captive wolf subordinates may court and mount an estrous female without interference from the alpha male, that is, until he detects the presence of this important sexual releasing hormone, at which point he actively defends his rights of exclusivity. The appearance of methyl *p*-hydroxybenzoate in a female wolf's uterine secretions apparently coincides with ovulation and standing heat. The compound has also been found in the estrous secretions of female dogs and has been shown to elicit sexual arousal and mounting behavior in males when applied to the vulvas of spayed females (Goodwin et al., 1979).

GUSTATION

The ability to taste depends on the activation of gustatory receptor cells concentrated in the taste buds. The taste buds are found in various papillae (foliate, fungiform, and circumvallate to name the most common) that are distributed over the surface of the dog's tongue. Taste buds contained in the fungiform papillae are located on the anterior two-thirds of the tongue and transmit gustatory information via the chorda tympani, a branch of the facial nerve (seventh cranial nerve). The posterior third of the tongue is associated primarily with the circumvallate papillae, which are innervated by the lingual branch of the glossopharyngeal nerve (ninth cranial nerve). Both the seventh and ninth cranial nerves form central synapses in the nucleus of the solitary tract located in the medulla. Ascending pathways are relayed from the solitary tract via the pontine nucleus to the ventral posteromedial (VPM) nucleus of the thalamus and then to higher somatosensory cortical areas associated with the conscious experience of taste. Another pathway from the pontine nucleus carries taste information via the lateral hypothalamus, amygdala, and basal forebrain areas. These subcortical pathways may be involved in the production of affective qualities associated with taste and the memory processes underlying taste aversions. In addition, some investigators have theorized that taste input to the lateral hypothalamus mediates the reinforcing effects of food (Shepherd, 1983; Carlson, 1994).

Taste buds are normally washed in a coating of saliva stimulating a baseline or zero firing rate. When stimulated with a chemical tastant, the taste receptor is either excited or inhibited. In both cases, a taste sensation is generated. In dogs, the most common receptors are those excited by sugar and various

sweet-tasting amino acids. Substances like citric acid also act on these same sweet taste receptors by inhibiting their rate of firing and thereby producing a sensation similar to what humans experience as sourness.

Similar papillae and taste buds in humans are specialized for the preferential detection of sugar (tip of the tongue), salt (to the front and side), sour (along the sides), and bitter (toward the back). Several taste studies reviewed by Kitchell (1976) indicated a similar localization pattern of taste receptors on the dog's tongue. The available evidence indicates that salty, sugary, and sour tastes are localized toward the front two-thirds of the tongue, while gustatory responses to bitter tastes are located toward the rear third of the tongue. Although the various taste qualities are most strongly responded to in these specific areas, taste sensations are not site exclusive but may be detected in various degrees and qualities over the surface of the tongue (Shepherd, 1983). There exists some disagreement in the literature regarding a dog's ability to taste salt. For example, according to Kitchell, several studies have demonstrated that dogs have a clear gustatory response to salt. In opposition to this view, Boudreau (1989) found that dogs totally lack salt-specific taste receptors. He noted that the ability to taste salt is common among mammals, especially herbivores, who need to find it in order to supplement a salt-deficient vegetarian diet. Since the carnivorous diet is already salt balanced, dogs (and cats) presumably have no need to seek salt in the environment and therefore do not possess the necessary taste capabilities for its detection. Interestingly, dogs are unique among many mammals studied in that dogs can taste furaneol, a sweet flavor found in fruits. Boudreau has speculated about the evolutionary function of the dog's ability to taste furaneol in terms of its omnivorous eating habits:

> Besides being intensely sweet, this compound also has a fragrant odor and is a character impact compound for many fruits. It is believed that this furaneol taste system is specific for fruit and is linked with the seed dispersing function of the dog. The presence of this taste system and its absence is readily detectable in the natural eating behavior of canines and felids. In a natural environment canines will supplement their small animal diet with fruit of the season, unlike felids. (1989:136)

The differentiation of tastes is biologically significant in terms of the animal's search for nutrients and the avoidance of poisons. Sour tastes may be used to estimate the relative acid/alkaline content of a food item, perhaps determining thereby its state of decay and available nutritive value. Dogs are especially sensitive to bitter substances, a biologically prepared tendency that may have survival value, since poisonous items are frequently bitter (Thompson, 1993). Like olfactory receptor cells, the taste buds are frequently replaced with new ones approximately every 10 days (Shepherd, 1983). Also, taste shares olfaction's sensitivity to the effects of habituation and adaptation, perhaps accounting for the dog's preference for novel food items over more familiar ones.

Taste has been much less studied than olfaction. It is known, however, that gustation is a precocious sense, being present in neonatal puppies at the time of birth and probably before. This has been confirmed by both conditioned-response testing (Stanley et al., 1963) as well as by direct measurement of nerve activity caused by gustatory stimulation (Ferrell, 1984a). Ferrell recorded the gustatory response of several puppies by inserting electrodes into the chorda tympani nerve bundle and then exposing them to various kinds of sugar. She found that puppies exhibited a stronger gustatory response to fructose than to other sugar flavors sampled (xylose, lactose, maltose, sucrose, and glucose). Interestingly, she found an almost equal spike occurring in the record when the pups' were exposed to distilled water. The gustatory response to fructose in neonatal puppies was found to be comparable to that of adult dogs.

The experience of flavor and taste preference depends on a composite of olfactory and gustatory factors, as well as past experience and learning. Garcia and colleagues (1966) found that intense and lasting taste aversions can be readily established toward a novel food item if its ingestion is followed by the induction of nausea. Such *taste aversions* oc-

cur even if nausea is induced after a delay of an hour or more. Pavlov (1927) reported an experiment performed by Zitovich that suggested that learning may play an important role in the development of food preferences. The subjects were puppies that had been taken away from their mother and hand reared. They were fed only milk for a "considerable" period of time. A fistula was implanted in the pups' salivary ducts to measure salivation output. When the puppies were finally shown food (meat or bread), they failed to exhibit a salivary response to the sight or smell of it. It was only after the puppies were encouraged to eat solid food that they began salivating in response to the sight or smell of such food.

Food preference is a somewhat complicated matter, involving four broad factors: genetic preparedness to recognize the sample as a potential food item, past experience with the food item, palatability of the food item, and its novelty. Kuo (1967) reported a study in which he removed chow puppies from their mothers at birth and divided them into three feeding groups: Group 1 was reared exclusively on a soy diet. Group 2 was fed a fruit and vegetable diet. Group 3 was sustained on a diet containing a variety of plant and animal ingredients. The various diets were supplemented with vitamins, minerals, and salt. Very young puppies were fed a liquid diet by hand and progressively moved to solid food as they matured. Kuo found that each group developed a specific preference for the food toward which it was accustomed. For instance, group 2 pups were familiar only with fruit and vegetable foods and refused to eat meat when offered it at 6 months of age. Group 1 pups were equally selective, refusing all food other than that made of soy. A puppy belonging to group 3 would readily eat almost any food offered to him. Kuo concluded that dogs exposed to limited novelty tend to develop exclusive preferences for familiar foods. Mugford (1977) reported conflicting results involving basenji and terrier puppies. He introduced puppies to assigned foods at weaning, maintaining them on those same food items for 16 weeks before testing. He found that two primary factors influenced food preferences: (1) preference was highly influenced by the relative palatability of the food (e.g., moistness), and (2) a lack of previous exposure to the food item (novelty) increased a puppy's preference for it. More specifically, he determined that novelty without palatability produced a short-term preference, whereas novelty plus a high degree of palatability produced a more long-term shift in preference. These results appear to contradict those of Kuo. Contrary to Kuo, Mugford found that puppies fed a restricted diet *preferred* novel foods over familiar ones. It should be noted, however, that an important independent variable differed between these two experiments: Kuo removed the puppies from their mother at birth, whereas Mugford waited until after weaning to do so. Apparently, prior to weaning, young dogs may be especially prone to develop lasting preferences for familiar food items, whereas such preferences may be more flexible after weaning.

A potential factor influencing taste preference overlooked by both of these studies is the possible role of fetal taste experiences. Some evidence suggests that the fetus may taste or swallow amniotic fluids, and Cain (1988) noted that these prenatal gustatory experiences may have an important effect on the development of taste preferences. For example, Smotherman (1982) found that an increased preference for apple juice by adult rats could be produced by exposing fetal rats to a solution of apple juice injected into the amniotic fluids shortly before birth (day 20 of gestation). As adults, the rats were tested and compared with regard to their relative appetites for apple juice, maple syrup, or tap water. Rats exposed to in utero apple juice solution exhibited a distinct preference for apple juice as adults. Interestingly, Smotherman also found that the treated rats were significantly less reactive (i.e., exhibited less pituitary-adrenal activity) to stressful stimulation as adults than were fetal controls injected with saline water. Also, Pedersen and Blass (1982) obtained additional evidence for the development of such prenatal preferences by exposing rat fetuses to citral (a tasteless lemon scent). Pups that had been exposed to citral in utero and again immediately after birth were attracted to nipples coated with the scent. However, control pups that had

been (1) exposed in utero only, (2) immediately after birth only, or (3) not exposed at all were not attracted to the nipples washed with citral. This study suggests that both prenatal and postnatal influences interact in combination to affect certain preferences.

Galef and Henderson (1972), who studied the food preferences of weanling rats, were particularly interested in determining the extent to which the mother's dietary intake influenced her young's preferences in food. They found that cues associated with food eaten by the lactating female are passed along (probably) through milk. Weanling rats tended to preferentially seek out food that the mother had eaten during lactation, even though it was less palatable than other food made available at the same time. The researchers pointed out that many substances—including antibiotics, sulfonamides, alkaloids, salicylates, bromides, quinine, alcohol, nicotine, DDT, and amphetamines (to name just some)—pass directly from the mother's milk into her suckling puppies. Additionally, they referred to a study by Ling and colleagues (1961) in support of the notion that complex taste and smell molecules associated with the mother's food may be passed into her milk. Ling and his associates found that the flavor of cow's milk is influenced by the sort of food eaten by her. Galef and Henderson concluded that it is reasonable to assume that taste preferences for specific foods are acquired (to some extent) through taste cues provided in the mother's milk prior to an animal's first experience with solid food.

Weanling puppies (2 to 4 months of age) are able to display a pronounced appetitive preference between foods containing as little as a 2% to 4% difference in fructose versus sucrose content. Moistened food containing 17% fructose is much more attractive than the same food containing 15% sucrose sweetening (Ferrell, 1984b). Other studies have shown that dogs exhibit a preference for cooked meat over raw (preferring beef over pork, lamb, chicken, and horsemeat—in that order) and sweetened foods. Dogs rendered anosmic still prefer sweetened foods and meat over dry food but do not exhibit the same range of preference for individual meats that smelling dogs do (Houpt, 1991). Dogs are especially fond of dairy products like cheese and butter. In addition to identifying preferred food items, taste mobilizes the gastrointestinal system to secret appropriate digestive juices. Both gastric acid and pancreatic enzyme secretions are differentially increased by direct taste stimulation of the dog's tongue (Powers et al., 1990).

Although dogs may have a preference for highly palatable and novel food, they can be persuaded to tolerate and thrive on a monotonous daily ration of dry food and fresh water. Acquiescing to a dog's novelty demands usually results in a finicky eater and what Fogle (1987) has aptly termed *starvation games*. One dog that I recall was so manipulative that he successfully trained his owner to feed him nothing but cheese steaks (less the rolls), a diet that may have played a significant physiological role in the dog's development of heightened irritability and aggressive behavioral problems (Mugford, 1987; Dodman et al., 1994). Dogs exposed to diets filled with daily novelty become progressively finicky and harder to please. Flavor-enhanced feeding and between-meal snacks, though highly desirable from a dog's viewpoint, may cause a dog to overeat and develop a weight problem. A recent survey performed by Kienzle and colleagues found that obese dogs often belong to obese owners who tend to "interpret their dog's every need as a request for food" (1998:2780S). Also, such dogs may become dangerously possessive over the desired food item when it is presented. Most finicky dogs will come around and eat what is presented to them after a day or two of hunger. A dog that has lost interest in food as the result of congestion or other olfactory dysfunction can be encouraged by putting food in the dog's mouth, thereby directly stimulating the taste buds and possibly eliciting appetitive interest (Hart and Hart, 1985).

Somatosensory System

The dog's body is equipped with a variety of receptors sensitive to stimuli impinging on the skin or arising from within the body itself. Specific receptors have evolved for the detection and measurement of pressure, vibration, heat and cold, chemicals, and vari-

ous noxious stimuli. In addition, internal receptors sensitive to joint location, muscle stretch, and tendon tension provide kinesthetic information about the relative location, direction, and action of the body. In combination, these highly specific sensory organs provide a tremendous amount of information about the external and internal environment and a dog's moment-to-moment orientation within it.

Dogs exhibit significant differences with respect to their individual responses to somatosensory stimulation. Some dogs are much more sensitive to touch than are others. Thresholds for stimulation are profoundly affected by an individual dog's emotional state, general physical condition, and past experience (learning). For example, fearful or hypervigilant dogs will likely respond to nociceptive stimulation at a much lower level of intensity than dogs that are relaxed and confident. Fearful dogs are also more likely to exhibit emotionally reactive behavior when stimulated. Similarly, dogs suffering from disease or deprivation may show significant changes in their relative responsiveness to certain kinds of stimulation. Hypothyroidism, for example, may cause affected dogs to seek warmth and avoid cold areas. Likewise, hungry dogs are more alert to stimuli associated with the acquisition of food. Somatosensory responsiveness is also significantly influenced by experience. A dog's response to stimulation may be decreased or increased depending on the presence or absence of previous habituating or sensitizing exposure to the evoking stimulus. The amount of past socialization received by a dog will also influence how that dog interprets and responds to tactile stimulation. Well-socialized dogs, for example, will more likely accept and respond in a friendly way to petting and hugs, whereas undersocialized dogs may only begrudgingly tolerate such tactile contact—if at all. Although the way in which dogs ultimately interpret and respond to sensory input is highly variable and dependent on many factors, the manner in which sensory input is obtained from the impinging external and internal environment follows a regular pattern of processing.

Mechanoreceptors

The largest sensory organ in the body is the skin, which contains numerous receptors adapted and specialized for the reception of specific sensory input. There are five basic categories of somatosensory receptors in the skin: nociceptors (associated with noxious or painful stimulation), proprioceptors (sensitive to body movement and position), thermoreceptors (responsive to heat and cold), chemoreceptors (sensitive to chemical stimulation), and mechanoreceptors (sensitive to physical changes, twisting, stretching, and pressure). Mechanoreceptors are the most numerous receptors in skin. At the base of each hair follicle, for example, is a group of pressure-sensitive hair-follicle receptors that are activated whenever the hair is disturbed by external movements that cause the surrounding tissue to stretch or bend. Follicle receptors of special importance to dogs are those associated with the vibrissae or whiskers located at various points on the face. The vibrissae provide dogs with information about nearby objects, coordinate the movement of the muzzle and mouth toward nearby objects, and may serve an important protective function against ocular injury by avoiding accidental collisions. In addition to direct mechanical stimulation, the vibrissae are responsive to vibrations and the subtle movement of air currents. The sensory information from the vibrissae is especially important for rats and cats. As noted in Chapter 3, Welker (1973) categorized rats as *feelers*, stemming from their extraordinary reliance on their whiskers for survival. In addition to indicating the presence of a nearby object to rats while in darkness, the vibrissae also appear to provide supplemental information about its shape, texture, and distance (Bear et al., 1996). An interesting possible cause of reflexive aggressive behavior occasionally exhibited by some dogs to a puff of air blown into their face may be related to a species-typical defensive reaction mediated by vibrissae. During combat between dogs, vibrissae may provide information about the opponent's close location and movements, perhaps mediating some measure of defense through the

reflexive organization of combative behavior. Motile vibrissae on the muzzle quickly flare and reorient in a forward direction when a dog is aggressively aroused, suggesting that they play some functional role. Sensory information originating in the face, including receptors associated with the vibrissae, is conducted by the trigeminal nerve. In addition to providing mechanoceptive and proprioceptive information about the face and jaw, the trigeminal nerve is an important conduit for the transmission of chemoceptive information resulting from the chemical stimulation of the nasal and oral mucosa (e.g., the nonolfactory sensation of alcohol vapor to the nose or the burning sensation it produces if placed on the tongue).

A number of other mechanoreceptors have been identified in the skin of mammals (Martin and Jessell, 1991). The skin is composed of two layers: the dermis and the epidermis. In the epidermal layer, a pressure-sensitive and slowly adapting receptor known as Merkel's receptor is found. Merkel's receptors respond to indentations produced near the surface of the skin. In humans, specialized pressure and vibration receptors are located in the elevated ridges of the epidermis, forming fingerprints. These Meissner's corpuscles are responsive to both touch and low-frequency vibrations (50 Hz). Meissner's corpuscles exhibit an extremely small receptive field and are employed to form fine tactile discriminations. Unlike Merkel's receptors, Meissner's corpuscles are rapidly adapting.

Deeper within the dermis are other pressure receptors called pacinian corpuscles. These onionlike structures are composed of several concentric layers of connective tissue that variably respond according to the amount of pressure applied to them. Pacinian corpuscles are responsive to a large receptive field involving both pressure and vibration but in a higher frequency range than observed in Meissner's corpuscles, approximately 200 to 300 Hz. They respond quickly and rapidly adapt to continuous stimulation. Other mechanoreceptors located in the dermis are Ruffini's corpuscles. Like pacinian corpuscles, Ruffini's corpuscles exhibit a relatively large receptive field. Unlike pacinian corpuscles, however, Ruffini's corpuscles are much slower to adapt to long periods of continuous stimulation.

Nociceptors

Nociceptors are free, unmyelinated (bare) nerve endings in the skin and body that respond to noxious stimulation that either damages or threatens to damage body tissue. The subjective experience of nociception is pain. Painful stimulation elicits species-typical escape reactions that serve to separate the organism from the source of noxious stimulation. Nociceptors are divided into four types, depending on the source of stimulation: mechanical (responds to sharp pressure), thermal (extremes of burning heat or freezing cold), chemical (stinging sensation of ammonia or pepper), and polymodal (nociceptors that combine sensitivity to a combination of mechanical, thermal, and chemical stimuli).

Pain results from the stimulation of nociceptive nerve endings terminating on the skin's surface and enervating most of the body's major organ systems. In addition to the direct stimulation of these specialized receptors, traumatic stimulation may also cause local tissue damage and the rapid release of pain-enhancing hormones, such as prostaglandin. The secretion of prostaglandin sensitizes nociceptive nerve endings to histamine—an inflammatory by-product of cell damage (Carlson, 1994). Aspirin and other anti-inflammatory medications produce their analgesic effects by disrupting the production of prostaglandins. Pain information is relayed along two pathways: a fast pain system and a slow pain system (Thompson, 1993). The fast pain system informs the brain immediately of the traumatic event ("Yelp!") followed by the slow pain system (throbbing, aching, and burning sensations), which maintains the feeling of constant painful sensation—even though the original stimulus has been removed. The fast pain system terminates in two thalamic nuclei: the ventrobasal complex (also associated with touch and pressure) and the posterior nucleus. From these thalamic nuclei, the impulse is relayed to the cerebral cortex. The slow pain system passes

through the reticular formation and projects to the hypothalamus and the limbic system (amygdala)—areas involved in the emotional interpretation of pain and the motivation of flight-freeze-fight reactions. The fast pain system is limited to surface nociception (the skin and mucosa) and is a more recent evolutionary development than the slow pain system, which services all bodily tissue except the brain, which is not sensitive to pain.

One effect of the slow pain system is the production of endorphins (a contraction of endogenous morphine). Endorphins are peptides (short protein molecules) produced by the brain in response to slow pain, pressure, and touch. Endorphins are also produced by the pituitary gland (beta-endorphins), which are released into the bloodstream together with other hormones such as adrenocorticotropic hormone (ACTH) as part of the general adaptation stress response. Endorphins circulate throughout the brain to various opioid receptor sites, including the hypothalamus, amygdala, and intralaminar thalamic nuclei. Interestingly, the fast pain system bypasses the emotional and motivational centers associated with avoidance learning and aggression. The fast pain system is a pure pain/startle reaction relayed directly to the cerebral cortex. It is not affected by endorphin activity or the effect of morphine. Naloxone, a molecule resembling morphine in many details, is an active antagonist of morphine and endorphins. Naloxone has little obvious effect on an animal, but it binds with opioid receptors in the brain. Consequently, the complementary pain-reducing and pleasure-enhancing effects of increased opioid activity are impeded. Naloxone is commonly used as a medication for the temporary management of some compulsive behavior disorders (Brown et al., 1987; Dodman et al., 1988), presumably based on the assumption that such disorders are, at least partially, mediated by the endogenous opioid system.

Proprioceptors

Proprioceptive sensitivity is essential for the smooth locomotor functioning of the body. The perception of the body's orientation in space and its coordinated movements are under the control of various brain centers, including the sensory motor cortex and cerebellum. Sensory information mediating this process is produced by proprioceptors located in the muscles and joints. These receptors provide fast moment-to-moment information about the body's movements and its orientation relative to the location of its different parts. There are two common proprioceptors: muscle spindles and Golgi tendon organs. Muscle spindles respond to the rate and amount of stretching that the working muscle undergoes. (Incidentally, stretch-sensitive receptors in the detrusor muscle of the bladder send signals indicating that the bladder is full and needful of evacuation.) Golgi tendon organs measure the amount of force being exerted by the muscle on the tendon. In addition, many other mechanoreceptors located in the surrounding connective tissue provide information about physical changes in the joint, including angle and velocity of movement. Besides providing information about the body's orientation and movement, proprioceptors also provide sensory information about the external world resulting from the physical manipulation of objects.

Balance

In addition to proprioceptive information, the ability to coordinate bodily movement and balance is made possible by sensory information provided by two vestibular structures in the inner ear: the semicircular canals and the vestibular sacs. The semicircular canals are composed of three tubular structures extending from the cochlea and set at 90 degree angles to one another. The canals are filled with a fluid substance called endolymph that shifts in a direction opposite to the body's movement. The displacement of cochlear fluid during rotational movement causes hairlike receptors to bend, thereby generating a nerve impulse. During linear movement or while standing still, balance is controlled by information from the vestibular sacs (the utricle and saccule). These sacs contain a jellylike substance in which otoliths or tiny stones are suspended. Gravity pulls the otoliths against receptor hair cells that, in

turn, produce signals about the relative position of the head to the line of gravity. Information from the semicircular canals and vestibular sacs is gathered in the vestibular nerve and relayed to the cerebellum and sensory motor cortex, where balance is finely coordinated.

Effects of Touch

Many studies have confirmed the enormous importance of touch for the ontogeny of normal emotional and social behavior. Harlow and Zimmerman (1959), for example, studied the comfort-seeking behavior of rhesus monkeys: Infant monkeys who had been separated from their biological mothers shortly after birth were offered two surrogate mother alternatives, one made of carpet and the other made of wire. The researchers found that the infant monkeys preferred surrogate mothers made of soft carpeting material and shunned artificial mothers made of wire, despite the fact that the wire surrogate provided milk whereas the carpet one did not. When Igel and Calvin (1960) replicated this experiment with puppies, they discovered that puppies also preferred a cloth nonlactating surrogate mother over a wire one that provided milk. In a series of experiments studying separation distress in puppies, Pettijohn and coworkers (1977) compared the effect of various stimulus conditions on the amount of distress vocalization exhibited by puppies that were briefly isolated from their mother and littermates (see Chapter 2). They found that separation distress vocalization was reduced by soft comfort objects (e.g., a piece of cloth), but food (novel and familiar) or hard play toys had no discernible effect on separation-related behavior. Curiously, the researchers also observed a decrease in distress when a mirror was put inside of the holding pen. Ostensibly, the puppies were comforted by viewing the image of themselves, and some even rubbed up against the mirror, apparently in a futile effort to make physical contact with the image.

The first systematic effort to quantify the calming effect of touch on dogs was performed by Gantt and coworkers (1966). Gantt observed that dogs in distress are calmed by social contact, exhibiting a significant decrease in both heart and respiratory rates while being petted. He referred to this phenomenon as the *effect of person*. Lynch and McCarthy (1969) reported that shock-elicited aversive arousal (as indicated by heart and respiratory rates) was reduced by petting. Also, they found that during classical conditioning, if the dogs were continuously petted during the preshock and postshock periods, heart rates were strongly dampened immediately before (anticipatory arousal) and after the shock was delivered (Lynch and McCarthy, 1967). Tuber (1986) noted the usefulness of massage, or what he calls the "soft exercise," for promoting calmness in dogs. He advised that training dogs to relax should be just as important as other training activities. Recently, Hennessy and colleagues (1998) reported evidence suggesting that it is not only petting but the way in which petting is done that yields the best effect on objective measures (e.g., cortisol levels) associated with reduced stress. The best results were obtained by utilizing deep muscle massage or long firm strokes of petting from the head to hindquarters. These findings underscore the value of massage for reducing stress in dogs. Massage and relaxation training have many applications in the management of dog behavior, especially in situations involving aversive emotional arousal.

Since Gantt's discovery, subsequent studies have shown that the effect of person is reciprocal, with humans also experiencing pronounced cardiovascular benefits from tactile contact with dogs (Katcher, 1981; Friedmann et al., 1983). Vormbrock and Grossberg (1988) confirmed previous studies indicating that petting causes a reduction of blood pressure in humans. In addition, they found that these physiological effects are not due to cognitive or conditioned associations but depend on direct tactile interaction between a person and a dog. The mere physical presence of a dog is insufficient; the dog must also be the object of petting to lower blood pressure (see Chapter 10).

Animals handled early in life exhibit many lasting benefits as the result of such exposure. Experiments with rats show that a minimum amount of preweaning handling results in in-

creased vitality and activity levels, more confidence, and greater resistance to disease; handled subjects are larger and more socially dominant; and, finally, handling has a significant positive impact on learning and problem-solving abilities, as well as reducing reactive emotionality (Morton, 1968; Fox, 1971a). Puppies handled early in life appear to obtain many similar benefits (Fox, 1978).

Touch mediates a great deal of social communication between a dog and others with whom the dog comes into contact (Lynch, 1970). Most training efforts exploit hedonically pleasurable or aversive responses mediated by touch receptors. Dogs learn to value gentle petting as a reward and rough handling as punishment. Touch is also an important modality of canine emotional expressiveness, whether it be a gentle lick on the chin, a casual pawing movement for attention, or a hard bite on the leg—the dog, too, understands the power of touch. Consequently, touch provides a basic medium for direct communication and intimate exchange based on analogous experiences of pleasure and pain shared by the human and the dog. Through the agency of touch, we develop an intuitive appreciation of dogs as emotional beings. Dogs react to our handling (whether positive or negative) in ways that are comparable to our own reactions undergoing similar stimulation. Humans and dogs appear to share an empathetic appreciation of one another through the modality of touch and tactile communication. Dogs cannot speak about how they feel, but they are, perhaps, more direct and transparent than virtually any human can be when communicating how they feel through the agency of physical posture, gesture, and various subtle movements and expressions of touch.

Reflexive Organization

Much of a dog's behavior is under the reflexive control of involuntary mechanisms. As discussed in Chapter 2, neonatal puppies exhibit a great variety of reflexes that are predominately geared to maintaining contact with the mother to secure basic survival needs. These early neonatal reflexes gradually disappear and are replaced by more centrally controlled behaviors as puppies mature. Neonatal reflexive behavior has been carefully studied and cataloged (Fox, 1964). Understanding how the body's reflexes work was the primary emphasis of Sherrington's (1906) experimental work. He discovered that many of the dog's apparently voluntary behaviors were to some extent under the control of involuntary reflexive mechanisms. A dog's scratch reflex, for example, could be elicited by applying an electrical "itch" to its skin. Although mechanical and stereotypic, the scratch response was organized and well directed toward the source of the itch. What makes this noteworthy is that the dogs involved were decerebrate, having undergone previous surgeries to cut nervous pathways going to (afferent) or leaving (efferent) the brain. Other surprising abilities of decerebrate dogs included unsteady treadmill walking, withdrawal and crossed extensor reflexes to pain (the stimulated leg flexes while the opposing leg extends in order to push away from the noxious stimulus), and differential gustatory responses (a swallow reflex was elicited by milk whereas noxious substances were expelled).

The Russian physiologist Ivan Sechenov, the father of reflexology, made several discoveries about reflexive behavior that anticipated the findings of Sherrington. The following is a description of one of his famous experiments with frogs:

> Cut off the head of a frog and place the decapitated animal on the table. For a few seconds it seems to be completely paralyzed; but before a minute has passed you see that it has recovered and assumed the posture peculiar to the frog when in a state of rest on dry land: its hind legs are tucked under it and it supports itself on the front legs like a dog. If you leave it alone, or to be more precise, if you do not touch its skin, it will remain motionless for a very long time. But the moment you touch its skin, it starts and then resumes its quiet posture. Pinch it somewhat stronger and it will, in all likelihood, jump as if trying to escape from pain. (1863/1965:6–7)

The above reflex actions (and many others) do not require voluntary effort but result from the wiring of nervous connections between sensory receptors, motor neurons, and

interneurons (a simple neural relay system) located in the brain stem and spinal cord.

Sherrington divided reflexive behavior into two broad categories: phasic and tonic. Phasic reflexes are those that occur quickly with a brief response, such as the patellar reflex (knee jerk). Tonic reflexes are those that involve sustained adjustments and equilibrating efforts over flexor/extensor dominance. An interesting example of tonic reflex action is thigmotaxis. Two instances of thigmotaxis can be readily observed in dogs. Fearful dogs tend to lean against their owner's body or may lay down on the ground as though pushing into it. This reaction is called positive thigmotaxis and is a common tonic reflex in fearful animals. Another example involves a dog's reaction to opposing pressure or force. Whenever a dog's body is pushed or pulled, the dog tends to react reflexively by responding in an opposing direction to the direction of the force applied to its body. Oppositional reflexes enable dogs to maintain physical equilibrium or to sustain a course of action when exposed to opposition. An especially common instance of this effect is seen when a dog pulls during walks, a tendency that is evoked by the owner's habit of pulling against the dog's forward movement. Such reflexive oppositional reactions explain why most trainers recommend that the leash be held in a slack manner and that the dog be corrected with a snapping action rather than a slow continuous pull.

Sherrington described several factors influencing the elicitation of reflexive action:

Threshold refers to the minimum stimulus intensity sufficient to elicit the reflex. A *high threshold* means that a relatively strong stimulus is needed to elicit a response, whereas a *low threshold* suggests that a relatively weak stimulus is needed to elicit a response. Altering response thresholds is an important part of effective behavior modification, especially involving emotional systems under the regulation of reflexive mechanisms.

Latency refers to the duration from the moment of stimulation to the onset of the reflexive action. Latency depends on the intensity of the stimulus involved and on the readiness of the animal to respond.

Irradiation refers to the tendency of an especially strong stimulus to elicit a generalized reaction extending to surrounding or associated neural systems.

Reciprocal inhibition neural systems refers to the tendency of elicited muscle actions to inhibit the actions of an opposite type. The elicitation of muscle reflexes involves three possible actions: flexion, extension, or a tonic combination of the two. Stimulating a group of muscles to flex causes the simultaneous inhibition of opposing extensor muscles. The concept of reciprocal inhibition was later adopted by Wolpe (1958) to describe the effect of counterconditioning and the process of systematic desensitization. Wolpe argued that relaxation/appetite and anxiety/fear are mutually exclusive affects that regulate each other through a mechanism of reciprocal inhibition—that is dogs cannot simultaneously feel anxious while relaxed or fearful while eating. The third characteristic of reciprocal inhibition (flexor/extensor tonic equilibrium) is analogous to situations in which opposing emotional alternatives are held in a stasis of conflict between the available options.

Fatigue occurs when repeated elicitation of a reflex action causes it to weaken or habituate. Habituation is the most basic form of learning observed in all animals from humans to sea snails.

Many basic biological functions are under the control of reflexive mechanisms. Although some reflexes can be influenced by voluntary efforts, most reflexes occur automatically, given the presence of a sufficiently salient stimulus. For instance, one can resist and possibly inhibit or slow the blink reflex elicited by touching the eyelashes, but it is much more difficult (if not impossible) to control pupillary constriction in the presence of bright light, stop salivation in the presence of food, or inhibit heart rate acceleration while in a fear-eliciting situation. Pavlov (1927) discovered that these sorts of behavioral and physiological events could be brought under the control of normally neutral stimuli through a conditioning process. The basic procedure was carried out by pairing the sound of a bell with the presentation of food. After a number of such contiguous

pairings between the neutral stimulus (bell) and the unconditioned stimulus (food), the previously neutral bell becomes a conditioned stimulus that is able to elicit a conditioned response—that is, a response that is similar to the original or unconditioned response. As is discussed in Chapter 6, classical conditioning is an important tool in a trainer's armamentarium for managing and controlling dog behavior.

EXTRASENSORY PERCEPTION

Do dogs possess a sixth sense? Many authors writing to a popular audience, among them trainers, veterinarians, and behavioral consultants, have suggested that dogs may use information derived from sources other than the normal senses (Fox, 1972, 1981; Woodhouse, 1982; Vine, 1983; Campbell, 1986). These beliefs have been reinforced in the public's mind by animal psychics claiming to communicate with dogs telepathically and to perform extraordinary feats, ranging from locating lost pets (both dead and alive) to diagnosing behavioral and medical problems by psychically "talking" with the distressed animals. Such extraordinary abilities have not been successfully demonstrated under controlled laboratory conditions; nonetheless, they are widely held to be real abilities and supported by the testimonies of many satisfied customers. Some dog trainers, most notably Woodhouse (1982), claim that a very active telepathic linkage exists between trainer and dog:

> It is extraordinary how dogs pick up praise straight from your brain almost before you have time to put it into words. A dog's mind is so quick in picking up your thoughts that, as you think them, they enter the dog's mind simultaneously. I have great difficulty in this matter in giving the owners commands in class, for the dog obeys my thoughts before my mouth has had a chance to give the owner the command. (1982:72)

What makes such statements so difficult to accept without a high degree of skepticism is that such abilities would be so easy to confirm or disprove through a series of simple experiments. If confirmed, a whole new vista of human-animal communication would be opened up, but to the best of my knowledge such confirmation has not been obtained. Although impressive anecdotal evidence has been collected over the years, together with some inconclusive scientific evidence (especially by J. B. Rhine and colleagues at Duke University), overall the picture provides little in the way of confident support for the existence of extrasensory activity. Nothing seems very authoritative or conclusive about this literature, although defenders believe that it is enough to "prove" the existence of such phenomena (Bardens, 1987). Undoubtedly, subtle links of communication exist between humans and animals that are not fully understood, but these links are most probably examples of extraordinary senses and empathetic exchange rather than extrasensory mediation and arcane abilities.

Clever Hans

To study extrasensory perception (ESP) from a scientific viewpoint, one must approach it with the same methods and attitude used to investigate natural phenomena. In essence, this means that adequate experiments must be devised to test the claims of persons attributing events and experiences to paranormal causation. Without such investigation, no conclusions regarding such phenomena can be legitimately drawn.

The story of Clever Hans (Pfungst, 1911/1965) provides an edifying backdrop for appreciating the need for safeguards and a scientific method when studying such phenomena. Hans, a Russian trotting horse, belonged to Wilhelm von Osten, a retired German schoolteacher and amateur horse trainer. Von Osten appears to have honestly believed that he had discovered a training method for instructing animals to communicate on a more sophisticated level with humans. He was able to convince many critical observers of the legitimacy of his horse's extraordinary ability to tap out answers with his hoof to mathematical problems, and to respond to other questions posed to him. This latter feat

was accomplished by von Osten assigning numerical values to letters, with which Hans could spell words by tapping out their numerical equivalence.

Hans's fantastic abilities were received with far-reaching international astonishment and interest. Various explanations were proposed to explain the horse's amazing abilities. Taken together, these accounts form a virtual monument to Ockham's razor (*Entia non sunt multiplicanda praeter necessitatem*: Entities are not to be multiplied beyond necessity) and the law of parsimony. These accounts ranged from trickery on the owner's part to telepathy. One of the scientific investigators of the Clever Hans phenomenon was O. Pfungst (1911/1965), who reported his observations in a book devoted to the subject. He described several of these theories, including one posited by a researcher (he refers to as a "natural philosopher") who wrote, "On the basis of most careful control, I have come to the conclusion, that the brain of the horse receives the thought waves which radiate from the brain of his master; for mental work is, according to the judgment of science, physical work" (1911/1965:28–29). This rather absurd concatenation of pseudoscience and mysticism echoes some of the current ways unexplained phenomena are explained in paranormal terms. The mystery of Clever Hans was finally solved when Pfungst demonstrated that the horse was actually responding to subtle cues emanating from his owner that told him when to stop tapping. The cues involved were slight and subtle upward head movements, barely perceptible upward movements of the eyebrows, and the flaring of the owner's nostrils. The size of the movements were estimated to be on the order of less than a millimeter and, in some instances, a mere deflection of one-fifth of a millimeter was accurately responded to by the horse.

Nora, Roger, and Fellow: Extraordinary Dogs

As Hans's fame spread through Europe, two dogs—Nora and Roger—also appeared on the scene, exhibiting fantastic abilities similar to those of Hans. Nora, a spaniel type, belonged to Emilio Rendich (an artist). After observing von Osten and Hans in action, the observant painter noted that von Osten constantly watched Hans's hoof tapping, while Hans, for his part, constantly observed his trainer. He surmised, like Pfungst, that Hans was responding to subtle cues emanating from his trainer: in particular, forward-leaning and backward-leaning movements. Also, Rendich believed that Hans had learned, more importantly, when to stop tapping rather than when to start. To test these hypotheses, using subtle forward and backward body movements as signals, he set out to train Nora (sometime before 1905) to paw and to stop pawing on cue. Reportedly, Nora could perform many of the same feats that Clever Hans exhibited (Candland, 1993).

In 1907, *Century Magazine* published an article titled "A Record of a Remarkable Dog," which was written about a dog named Roger under the pseudonym of B.B.E. Roger, a 3- to 4-year-old spaniel mix, came into B.B.E.'s possession with a history of trouble and problems. Before being adopted by B.B.E., Roger had been rejected from two previous homes as an "impossible" puppy. Withdrawn and depressed, Roger had apparently received some abusive treatment, but after 3 months of gentle handling, he gradually emerged and slowly began to exhibit an increased interest, attentiveness, and trust toward his new owner and surroundings. As his confidence improved, B.B.E. commenced efforts to educate him, starting with simple parlor tricks and progressing to more elaborate objectives as the dog's ability permitted. Roger proved to be a very intelligent and willing learner. For example, B.B.E. was able teach Roger to pick up individual playing cards from a pile of eight cards laid out in front of him. His method was crude but effective. He simply grasped Roger's paw and placed it over the selected card and then repeated its type and suit—for example, "That is the ace of clubs, Roger—ace of clubs." This was repeated four or five times. Roger was then given a cookie as a reward for his

cooperation. Gradually, Roger learned to voluntarily place his paw on the selected card for which he would receive a treat.

B.B.E. carried out these training activities daily for 10-minute periods over 2 months. In the beginning, the correct card was kept in the same position, but as Roger's skills improved, it was placed in random locations relative to the other eight cards. After an additional month of training, Roger was taught to locate another card—this time, the ace of hearts. However, to B.B.E.'s amazement, Roger learned this new card trick after only a single trial of training. Subsequently, Roger learned to locate all eight cards in rapid succession, apparently having acquired a "learning set" that made variations of the task progressively more easy to learn. The next training goal was to teach Roger how to spell his name. This task was accomplished by placing Roger's paw sequentially on the various cards spelling out his name. Each trial was followed by the appropriate command "Where is the first letter?" and then "Where is the second?" and so on. Amazingly, Roger learned to spell his name within five or six sessions. B.B.E. also taught Roger how to add every combination of 2 up to 12. For example, B.B.E. would command "Show me 2 + 6" and would then place Roger's foot on the correct card containing the number 8. B.B.E. commented that Roger at this point in his education seemed never to forget, even after a single exposure. Finally, B.B.E. discovered to his great astonishment that Roger could spell "dog" and could even translate it into German (*hund*) and French (*chien*)—tasks that he had learned with no previous training!

B.B.E. performed a series of experiments to determine how Roger was performing these incredible feats of learning. In one of these experiments, he instructed Roger to add 2 + 3; however, instead of looking at the correct card, he looked at another card with the number 8 drawn on it. As he expected, Roger placed his foot on the card marked 8 instead of the one marked with the number 5. B.B.E. erroneously inferred from the evidence that Roger was responding to a visual image produced in his mind. He conjectured that this visual image was somehow unconsciously transmitted to the telepathically receptive dog: "All the time when he seemed to be learning rapidly, he had been simply getting the cards of which I thought" (B.B.E., 1907/1908:601). B.B.E. adopted the now familiar ESP explanation for his dog's remarkable abilities, speculating that he had tapped some previously unappreciated channel of interspecies communication with Roger:

> May it not be possible that between our minds and the minds of the lower animals there is a deep and quite subtle connection which may yet be explained in the future, but only by the use of the utmost sympathy and love? (1907/1908:602)

Century Magazine asked R. M. Yerkes of Harvard University to investigate. During Yerkes's initial observations of B.B.E. and Roger, he was unable to detect any obvious signals coming from B.B.E. that might explain the dog's extraordinary abilities. On a later occasion, however, following a 6-week separation between B.B.E. and Roger, Yerkes observed that B.B.E. did, in fact, provide Roger with subtle guidance. These movements were made more evident since Roger had been out of practice and apparently needed extra help. However, Yerkes (1907/1908) noted that "these movements were not readily seen by the observer when Roger is in practice and does his best. It is highly probable that the dog's visual sensitiveness to movement is greater than ours."

Another dog that attracted considerable fame and notoriety as the result of his remarkable learning abilities was a German shepherd named Fellow (Warden and Warner, 1928). The dog was owned and trained by J. Herbert, an avid fancier and breeder. Fellow appeared in a number of movies, playing the typical roles assigned to dogs during the 1920s. What made Fellow special among dogs was his reputed ability to understand over 400 different words, forming definite associations between them and specific objects, places, and actions. According to Warden and Warner, Herbert made no extraordinary claims about the possible operation of higher reasoning powers or extrasensory abilities underlying Fellow's proficiency at understanding commands. In fact, it was Herbert who contacted Warden and

Warner—both psychologists at Columbia University—to evaluate the extent of Fellow's accomplishments. The researchers conducted a number of tests with Fellow, concluding that he did possess most of the abilities attributed to him by his owner. In one series of tests, the experimenters and Herbert concealed themselves behind a screen from where commands were issued to Fellow. Even under such difficult conditions, the dog was still able to respond accurately to over 50 verbal commands of the type "Sit," "Down," "Take a walk," and "Step back." Although these so-called type I responses were readily performed by Fellow, other commands that required him to move toward some specific place or object—type II responses—were performed much more poorly and hesitatingly under such conditions. They observed that Fellow made few mistakes performing type II tasks (e.g., "Jump on the table," "Go and look out the window," and "Put your head on the chair") as long as he remained in full view of Herbert. However, when signaled to perform these same tasks from behind the screen, he made many more errors. Consequently, Warden and Warner performed an additional experiment to isolate the pertinent visual cues influencing Fellow's performance:

> It was now decided to make a deliberate attempt to confuse the dog, by having Mr. Herbert come from behind the screen and issue the commands, at the same time looking away from the place or object which the dog was supposed to approach in performing, with the following result:
>
> 1. "Go put your head on the chair"—dog jumps up on table at which Herbert is looking.
> 2. "Jump over the chair, good dog"—dog goes over to window at which Herbert is looking.
> 3. "Go over to the door"—approaches table at which Herbert is looking.
> 4. "Go over to the door, now I say"—goes to window slowly, toward which Herbert has turned.
> 5. "Go take a walk around the room"—dog goes to door at which Herbert is looking.
>
> Mr. Herbert was then blindfolded and the test repeated to see whether Fellow got his cue from watching his master's eyes or from the general orientation of head and body. Similar results were now obtained showing that the latter factor is most likely the important one. (Warden and Warner, 1928:22–23)

These various tests and experiments confirmed that Fellow had attained an extraordinary ability to understand and respond to a variety of verbal and gestural cues. However, the most important question remains unanswered—How? According to Herbert, Fellow's successful training resulted from a regular practice of speaking to him "constantly almost from birth" onward in the manner of a parent to a child. Herbert claimed to have refrained from the use of corporal punishment, and only occasionally scolded Fellow when discipline was necessary. Unfortunately, little more was written about Herbert's accomplishment as a trainer and the finer details of his methodology.

Although the foregoing examples may lack the mystery and excitement of ESP, such extraordinary perceptual and learning abilities are of tremendous significance in themselves for an appreciation of the dog's perceptual abilities and the dog's relationship with humans. In all of the aforementioned cases involving extraordinary abilities, one factor seems to stand out above all others—the importance of close familiarity between the performing animal and human trainer. Hediger (1981), for example, argued persuasively in this regard that the crucial factor in Clever Hans's success was the high degree of familiarity existing between him and his trainer von Osten. Without the medium of intimate familiarity, unconscious gestures of such refinement as those employed by von Osten would never have been observed by the horse. Clearly, Hans's ability to read the unintentional cues of his trainer was an inadvertent outcome of the close relationship resulting from the training process itself and not dependent on extraordinary abilities or telepathy. Likewise, in the cases of Nora and Roger, a high degree of familiarity and affection was also evident, with B.B.E.'s revealing attribution of "sympathy and love" serving as a testimonial to the relevance of such factors in the development of remarkable animals. Finally, Herbert's method for instructing Fel-

low depended on close interaction and intimate communication between himself and the dog. These observations emphasize the relevance of enhanced affection, communication, and trust in the training process. Without such familiarity and affection-informing training activities, both dogs and trainers suffer a great loss. The dogs, on the one hand, will likely never reach their full potential and, on the other, the trainers are cheated of the full range of benefits and joy derived from affectionate companionship with dogs.

Extrasensory or Extrasensitive?

Although not all psychic phenomena can be explained by appealing to familiarity, intimacy, and affection; undoubtedly such factors do play a role in some forms of "telepathic" communication between intimate friends or human-animal companions in which the parties appear to know what each other is privately thinking or feeling without actually needing to communicate it directly. However, such connectedness may not depend so much on *extrasensory* abilities as it does on *extrasensitive* abilities. Many examples of animal ESP (e.g., amazing tales of psi trailing, anticipating important events like earthquakes before they occur, and experiencing the distress of a loved one suffering at a remote location) have been noted and discussed in various contexts, but to my knowledge none have fared very well under scientific scrutiny. Even though some experts in the field have expressed affirmative opinions concerning the possible existence of psychic phenomena, it remains a highly speculative area needful of much more research. Obviously, the many questions regarding ESP and animals are not going to be answered without such study. In the meanwhile, perhaps, the best one can do is maintain an open but critical mind with regard to such claims and phenomena.

Finally, it should be noted that at least some "paranormal" phenomena may be the result of sensory abilities not yet identified. For example, bats use echolocation to navigate around objects in their flight path and to locate prey insects, but before Griffin's discoveries concerning how this process actually worked, it remained unknown and liable to unprofitable speculation. The echolocating apparatus is incredibly sensitive. Even under conditions of pitch darkness, bats can recognize prey insects from similar nonprey insects on the basis of shape differences derived from echo information alone. Humans, too, can derive significant information from echoed sounds:

> Blind people, and blindfolded volunteers who have had considerable practice, can detect and classify objects in their vicinity by emitting audible sounds and hearing subtle differences depending on the presence of the object. But, curiously enough, many of the most proficient do not consciously recognize that they are accomplishing this by the sense of hearing. Instead they report that they simply feel that something is out there, and a common term for this ability is "facial vision." ... Nevertheless the feeling and the alleged "vision" cease almost totally if they can make no sounds or if their hearing is blocked. (Griffin, 1992:238)

It is not hard to see how these abilities could be wrongly interpreted as being the result of paranormal causation by persons wishing to interpret them as such. In addition to echolocation, many similar examples can be cited that testify to the phenomenal and varied sensory abilities of animals, including the fascinating dances of bees described by von Frisch, the remarkable migratory journeys of animals navigated by electromagnetic information, the infrared-radiation-sensing abilities of snakes, the electricity-sensing ability of some fishes, and the olfactory sensitivity of moths—many of these abilities might have been (and were) considered extrasensory 50 years ago and accounted for by various supernatural explanations instead of being recognized as belonging to the animal's special sensory accoutrements (Rhine and Pratt, 1957).

Perhaps dogs do possess some not fully understood extrasensory ability, but only scientific research will answer the question definitively one way or the other. Actually, all of the canine senses are capable of extraordinary sensitivity and incredible feats without resorting to extrasensory help. Besides the quality of the dog's inherited sensory abilities, ultimately the most influential factor in the actualization (or degeneration) of the dog's sen-

sory and mental capacities is experience. Sensory abilities are both dynamic and conservative. Although they appear to remain the same from day to day, they actually change under the demands made upon them. These various changes are often slow and imperceptible, but changes do occur, educating the dog to see, hear, smell, taste, touch, and to move about with precise coordinated movements. The mind of the dog obtains a clear awareness of the environment through the effortful exercise and training of the senses. The refinement of sensory acuity and intelligence depends on these actualizing influences and the organizing functions provided by daily training and practice. Some experiences reported by scientific observers, though, simply cannot be so neatly explained, so I offer the following anecdote provided by Worden to remind the reader that the book is not yet closed on the issue of extrasensory perception in dogs:

> Belief in the popularly termed "sixth sense" of the dog is widespread, and one is always coming across almost incredible stories—told usually in an attempt to demonstrate the dog's "intelligence". It must be conceded that we have not as yet adequate explanations of homing behaviour or of many other surprising canine feats. I can add one bonafide case, in a Scottish terrier, Sheila, who was devoted to me and who remained with my parents at East Barnet from 1940 onwards, when she was seven years old, while I was working at Cambridge. As often as I could—but sometimes at intervals of some weeks—I would return home, or call in on my way to London, but my visits were usually unannounced, at different times of the day, and by any of a considerable number of local trains with which I had connected at Hatfield. Yet almost invariably Sheila would rise in pleasurable anticipation when the particular train bearing me was heard, some half a mile away, approaching the local station, and thereby inform my mother of my coming. There were over thirty stopping trains a day traveling in that direction. (1959:973)

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5

Biological and Dispositional Constraints on Learning

At every moment an animal's sense organs are being bombarded by physical energy in many forms. To this chiaroscuro it responds selectively. The selectivity in its responsiveness must influence what it can learn.

R. A. Hinde and J. Stevenson-Hinde *Constraints on Learning* (1973)

The epigenesis of behavior is guided by a complex mix of innate and experiential factors. The evolved sensory and neurobiological organization exhibited by dogs predispose them to behave in unique species-typical ways. Although biology contributes a great deal to the way dogs behave and how they adapt to the environment, without the nurturing influence of experience and learning, this innate potential would remain dormant and unactualized.

Nature Versus Nurture

The relative importance of biology (nature) versus experience (nurture) for the organization of behavior is the central issue fueling the nature-nurture controversy. This circular (and somewhat self-serving) dispute is maintained, on the one hand, by proponents of nature (often ethologists), who emphasize the importance of evolution and phylogenesis. On the other hand, proponents of nurture (usually behaviorists) underscore the ultimate importance of experience and learning. Obviously, both sides of the debate are partly right, with both genes and experience contributing to the development of behavior. However, to compare the relative importance of the two factors separately is analogous to asking whether hydrogen or oxygen is more important in the makeup of water. In the words of Lorenz, "any attempt to separate phylogenetically and individually adapted characters and properties of behavior, either conceptually or in the course of practical ex-

periments, must necessarily be considered as hopeless and devoid of sense, as any trait of behavior, however minute, is automatically regarded, on principle, as being influenced by both factors achieving adaptation" (1965:5). The fact is that it takes both hydrogen and oxygen to make water. Without hydrogen there is no water and, likewise, without oxygen there is no water. A similar interdependent relationship holds between the influence of nature and nurture in the ontogeny of behavior. The important issue at stake here is not the relative dominance of one factor over the other but the dynamic interplay of the two in developing animals. Genes per se do not impact directly on behavior, just as behavior per se does not impact on genes. Genes exercise an indirect influence on behavior by regulating the operation of biochemical mechanisms underlying the expression of behavior. Conversely, although genes cannot be directly affected by experience, the expression of genes and the biochemical substrates that they regulate can be influenced by behavior and experience.

A dog's behavior is the outcome of a developmental process (epigenesis) in which inherited genotypic characteristics interface with and adapt to the surrounding environment, thereby expressing the dog's behavioral phenotype (Fig. 5.1). Behavioral and biological development take place within a context of inherited constraints, sufficiently variable to allow for change according to the necessity dictated by an animal's unique experience and interaction with the environment. This adjustment to the demands of the physical and social environment depends on learning, but learning is possible only to the extent that an animal is genetically prepared to learn. Further, the organization of behavior itself is genetically programmed to be flexible and variable but only within definite limits. Survival depends on an animal learning from past experiences, adjusting its behavior appropriately to current circumstances, and forming reliable predictions about similar situations in the future. In essence, biology and genetics define the limits of how and what an animal learns, whereas experience dictates the moment-to-moment direction of these behavioral changes.

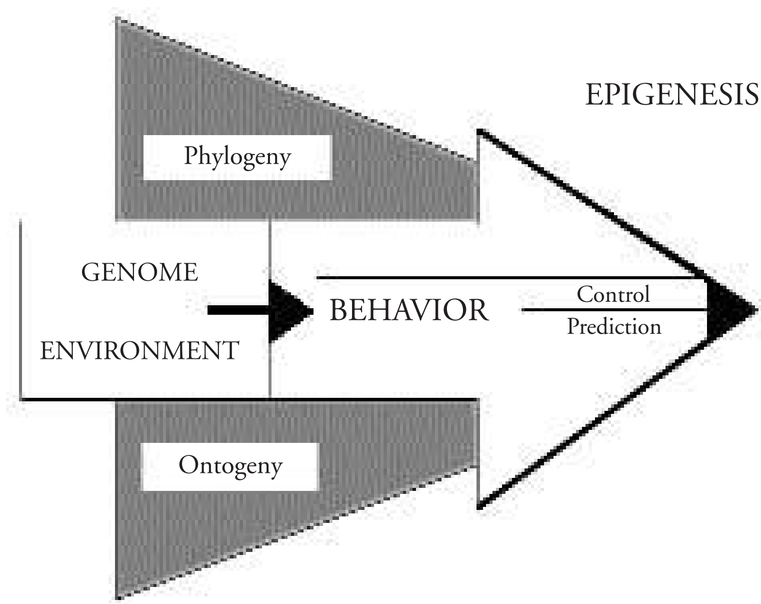

Fig. 5.1. The dog's development occurs under the influence of a complex set of biological and experiential factors.

Instincts, "Fixed" Action Patterns, and Functional Systems

The experimental study of animal behavior has produced great strides in our understanding of how animals learn. Unfortunately, however, the majority of this research has been confined to a narrow range of animal species (especially pigeons and rats) and limited to an arbitrary set of behaviors (e.g., maze learning, key pecking, lever pressing, and various other simple behaviors). Although the scientific productivity of such concentration is undeniable, over the years it has become increasingly evident that such investigation has failed in many important respects. Early on, Beach (1950/1971) criticized several aspects of this situation. He expressed strong reservations about the excessive reliance on rats as experimental animals and the rather exclusive experimental focus on learning and conditioning phenomena. He argued that the scientific study of animal behavior was at risk of becoming dangerously narrow and specialized—a psychology of pigeons and rats "which may or may not apply to other species and other situations" (1950/1971:12). He observed that such studies far outnumbered and overshadowed the investigation of other important areas of animal behavior research. According to Beach, an area of research that has suffered the most from this overconcentration is *instinct*:

> Another very important disadvantage of the present method in animal studies is that because of their preoccupation with a few species and a few types of behavior, psychologists are led to neglect many complex patterns of response that stand in urgent need of systematic analysis. The best example of this tendency is seen in the current attitude toward so-called "instinctive" behavior. ... The growing emphasis upon learning has produced a complementary reduction in the amount of study devoted to what is generally referred to as "unlearned behavior." ... Data relevant to all but a few "unlearned" reactions are too scanty to permit any definite conclusion concerning the role of experience in the shaping of the response. And those few cases in which an exhaustive analysis has been attempted show that the development of the behavior under scrutiny is usually more complicated than a superficial examination could possibly indicate (1950/1971:12).

Although pigeons and rodents remain the most common animals studied in laboratories, since Beach's admonitory address the learning ability of many other species has been investigated (Bitterman, 1988; Krasne and Glanzman, 1995).

The importance of instinctual mechanisms and species-typical action patterns should not be overlooked in the analysis of behavior and understanding its motivation. Among other things, instincts preserve genetic information about an animal's biobehavioral past. Nature is conservative and under natural circumstances many biological constraints and pressures are maintained from generation to generation in the interaction between animals and the environment. These constants have resulted in the gradual genetic codification of vital biological information produced by the interaction of an animal species with the surrounding environment over the course of its evolution. Although behavior itself is not directly encoded in an animal's genome, various genetic instructions are orchestrated by the genome that provide the biological substrate for the expression of species-typical behavior.

An instinctive mechanism that has drawn a tremendous amount of attention is the fixed action pattern (FAP). Complex and regular patterns of stereotypic behavior, not dependent on learning for their expression, are referred to as fixed action patterns. Although some disagreement exists regarding just how "fixed" such motor patterns are, the concept is a useful one for understanding many more or less unlearned features of dog behavior. Although FAPs are instinctive, instincts are not identical with FAPs. For example, maternal care in dogs is not an FAP, yet certain components of maternal care are innately programmed FAPs. Thus, immediately after birth, the mother removes the allantoic sac and severs the umbilical cord with her carnassial teeth—this behavior is highly stereotypic from puppy to puppy. The puppy is licked dry and the umbilical cord cut shorter if necessary. Such licking and stimulation elicits

various muscular reflexes and breathing. Another maternal FAP is the mother's stimulation of elimination. Newborn puppies are unable to eliminate voluntarily for about the first 2 weeks of life, thus requiring that the mother elicit elimination by licking the anogenital area and ingesting the neonate's excreta. The exact signs or releasing stimuli controlling these two epimeletic (care-giving) patterns are not known. Likewise, not all of the components involved in the dog's sexual behavior can be characterized as FAPs, but some sequences are FAPs. For instance, the female's practice of averting her tail to one side before intromission or the male's action of clasping and thrusting are FAPs. These actions are stereotypic and *hardwired* motor programs mediated by specific innate releasing mechanisms (IRMs).

FAPs depend on an inner readiness (appetitive, emotional, and hormonal) for action, a releasing or sign stimulus of sufficient strength to trigger the IRM, and the excitation of an appropriate motor program. Although experience and learning modify to some extent most instinctive behavior patterns, the general form and expression of an FAP is innately programmed and not subject to learning. It is useful to divide FAPs into two distinct components: appetitive and consummatory. Among animals of the same species, appetitive patterns of behavior may vary greatly, but the manner in which they consummate drive-directed behavior is uniform and stereotypic from individual to individual. However, an FAP's evocation is subject to change depending on an animal's accumulating readiness to act or, what Lorenz has termed, the ever-changing action-specific potential (ASP). Animals under a high motivational influence tend to respond to a minimum sign or releaser stimulus, whereas animals under a low ASP may require a correspondingly stronger releaser to evoke the appropriate FAP. Animals under a high level of "drive energy" may spontaneously discharge an FAP without appropriate stimulation. These spontaneous FAP discharges are referred to as vacuum activities. Lorenz views the canine custom of urinary scent marking as a good example illustrating these various motivational features underlying the FAP:

> The motor patterns of urination performed by a male dog show all the phenomena here under discussion. A very strong releasing stimulus situation, such as the smell of a rival's mark in the dog's own territory, will cause him to lift his leg even when the amount of urine at his disposal is, at the moment, negligible. Even under the pressure of a much higher urinating potential, the dog will still look for releasing stimulus situations, such as upright objects, preferably on exposed corners, at which to lift his leg. Under extreme internal pressure he will forgo every external stimulation and even forget the conditioned inhibition of house training and urinate on the carpet—in this pitiable situation usually without even lifting his leg. (1982:186)

In addition to elimination, urinary behavior patterns serve many important social and reproductive functions—imperatives belonging specifically to the species. Given the presence of an appropriate releasing stimulus (a scent post overmarked by a strange dog), an intact adult male dog will readily mark with a distinctive leg-lifting movement. This movement does not depend on learning to occur but is mediated by a genetically encoded IRM, hormonal influences, and specific releasing stimuli (perhaps a pheromone) impinging on the dog from the environment. The autonomous character of this behavior makes its initial expression almost comical in effect. Many young dogs when first discovering this new ability may hop along with head cocked around curiously observing the perplexing action *happening* to them. The leg-lifting movement does not appear to be an action that they voluntary choose to express, but rather one that comes over them under the right set of circumstances. As is characteristic of many fixed action sequences, it is very hard to train a dog to lift its leg on command, even though the dog may perform the action many times a day. The resistance of leg lifting to voluntary control supports the view that it is an instinctive response controlled at a primitive level of neural organization. This points to an important criterion of the FAP: that its occurrence is spontaneous and not subject to learning (or much learning) for its display. Although the FAP is not dependent on learning for its appearance, it is not entirely independent of the actualizing influ-

ence of experience either. Without an experiential context or field of action the FAP will remain in a dormant and potential state.

Instinctual Learning

The historical antagonism between ethology and behaviorism was based to a large extent on the relative importance each discipline placed on the role of learning in the development of behavior. This opposition was embodied in the careers and theoretical orientations of B. F. Skinner (1974) and Konrad Lorenz (1982). Skinner emphasized the importance of experimental analysis and learning as they occur under controlled laboratory conditions. Lorenz, on the other hand, downplayed the importance of experimentation and stressed instead direct observation of animal behavior occurring within its natural setting. Whereas behaviorists believed that behavior could be best explained in terms of learning, ethologists objected to this narrow focus and emphasized the significance of phylogenetic or biological contributions governing behavior. Both of these positions have turned out to be excessively exclusionary and doctrinaire. Certainly, the behavior of many animals is guided by instinctual mechanisms and various programmed motor patterns, but these innate contributions are not necessarily rigid nor entirely outside of the influence of learning. Further, in conjunction with an animal's biological endowment, learning itself is an evolutionary adaptation that determines (in terms of general potential) what animals will learn and how they will learn it. Some adaptations are learned readily, some slowly, and some not at all.

William James defined instinct "as the faculty of acting in such a way as to produce certain ends, without foresight of the ends, and without previous education in the performance" (1890/1950:383). According to James, instinctive behavior consists of reflexes and impulses linked together to form complicated behavior patterns and tendencies. Although many behavioral adjustments to the environment are biologically encoded as predispositions or even imperatives to action, such instinctive impulses are not entirely immune to the influence of experience. For example, in the case of animals possessing a well-developed memory, the first expression of an instinctive behavior may be a spontaneous response occurring without much purpose, but subsequent displays will be progressively influenced by experience and the effect of learning. The behavior is still instinctive but is now expressed under the additional influence of some expectation of producing a result (Thorpe, 1956/1966).

Unlike many of his contemporaries, James did not believe that instincts were regulated by rational self-control—at least directly: "Reason, per se, can inhibit no impulses; the only thing that can neutralize an impulse is an impulse the other way" (1890/1950:393). In other words, instincts are regulated by the operations of other instincts. However, through inferences derived from experience, an animal may learn how to control impulsive behavior indirectly by evoking opposing impulses to block its expression. For example, the impulse to act aggressively is not inhibited by a dog's exercise of better judgment, but through the simultaneous evocation of opposing instincts like fear of reprisal or affection for the object of anger. Fear is not overcome by telling oneself that there is nothing to fear, but by evoking opposing impulses to fear like relaxation or appetitive arousal.

Seligman and Hager described the relationship between learning and instinct in terms of a continuity in which "'learning' is continuous with 'instinct'" (1972:5), whereas Kuo employed a much more colorful terminology when referring to this functional relationship: "like one of a pair of inseparable, monstrous Siamese twins with one side of the body in common from head to toe, the term learning cannot by redefinition be detached from the concept of instinct" (1967:140). Long ago, David Hume eloquently characterized the close relationship between learning and instinct, while emphasizing the similarities existing between humans and animals with regard to the way each benefits from experience and observation:

> When we have lived any time, and have been accustomed to the uniformity of nature, we acquire a general habit, by which we always transfer the known to the unknown, and con-

> ceive the latter to resemble the former. By means of this general habitual principle, we regard even one experiment as the foundation of reasoning, and expect a similar event with some degree of certainty, where the experiment has been made accurately and free from all foreign circumstances. It is therefore considered as a matter of great importance to observe the consequences of things. ... But though animals learn many parts of their knowledge from observation, there are also many parts of it, which they derive from the original hand of nature; which much exceed the share of capacity they possess on ordinary occasions; and in which they improve, little or nothing, by the longest practice and experience. These we denominate instincts, and are so apt to admire as something very extraordinary, and inexplicable by all the disquisitions of human understanding. But our wonder will, perhaps, cease or diminish, when we consider, that the experimental reasoning itself, which we possess in common with beasts, and on which the whole conduct of life depends, is nothing but a species of instinct or mechanical power, that acts in us unknown to ourselves; and in its chief operations, is not directed by any such relations or comparisons of ideas, as are the proper objects of our intellectual faculties. Though the instinct be different, yet still it is an instinct, which teaches a man to avoid the fire; as much as that, which teaches a bird, with such exactness, the art of incubation, and the whole economy and order of its nursery. (1748/1988:99)

Dancing Bees

Even among insects, learning serves many adaptive functions. Von Frisch (1953) demonstrated the importance of learning for the bee's adaptation and success as a species. He observed, for example, that individual bees are typically flower constant, that is, they tend to forage on a single kind of flower rather than sampling many different types. This aspect of bee foraging is of great benefit to flowers, which depend on bees for pollination. If bees moved haphazardly from one flower species to another, they would not be a very efficient vehicle for the distribution of pollen between flowers of the same species. Von Frisch found that such constancy also provided bees with an important advantage. Each flower species poses special problems for bees with regard to the harvesting of nectar. It may take as many as five or six visits before a bee can easily find and harvest the nectar. The harvesting of nectar is an acquired skill that is mastered by practice. By specializing on one flower, a bee learns how to procure the hidden nectar inside most effectively without wasting time.

Next, von Frisch asked, how do bees discriminate the right flowers from all the rest competing for their attention? According to his experiments, bees acquire the ability to recognize the right flower through associative learning processes mediated by the senses of smell and sight. In one experiment, bees were fed sugar water while being exposed to the odor of bitter orange. After a number of visits, the bees showed a strong preference for the odor. Von Frisch next performed an experiment in which the odor was placed inside a box with a hole drilled into it so that the bees could freely enter. The box with the preferred scent was lined up with several other boxes, so that the bees had to choose the correct one containing bitter orange and sugar water from many other scents vying for attention. He found that the bees were able to discriminate the scent of bitter orange from over a dozen odors placed inside the other boxes.

To test the role of sight in this flower selection process, he performed another series of experiments. First, the bees were fed sugar water in a blue box scented with the oil of jasmine. The bees quickly learn to go to the blue box in search of sugar. Subsequently, he removed the sugar water and jasmine scent and placed it into an uncolored box located some distance from the blue one. The bees, again, oriented toward the blue box while in flight. However, upon discovering that the scent of jasmine was not present, they did not enter but searched the other boxes for the preferred scent of jasmine. When they finally found the scented box, they entered without hesitation. From these experiments, he concluded that bees use sight to locate a prospective flower from a distance but use smell to confirm that it is the correct one before alighting on it to forage. Other studies have shown that bees also estimate the availability

of food according to a time reference (Gallistel, 1990). An interesting example of how bee learning forms coherent sets or learning units was discovered while studying the bee's ability to time access to food. In one experiment, bees were fed unscented food, except for a brief half-hour period each day. Subsequent tests showed that bees chose unscented food over scented food, except during that same half-hour period. Not only are color, scent, and time learned as a set but add also shape, landmarks, and locality—if one element is changed, the entire set must be relearned. Even more extraordinary feats of learning and communication are found in the bee's dances. Such dances give other foraging hive members specific information about the location (direction and distance) of food resources. Excellent secondary information concerning this behavior can be found in Gould (1982) and Griffin (1981).

The way that bees learn is rigidly programmed. As just noted, bees can quickly learn to associate a specific color and odor with food, but how they learn this sort of discrimination is strictly defined. Gould (1979) reviewed bee research that showed that bees associate color with food for *only* a brief 2-second moment just before landing and learn landmarks associated with the food's location *only* as they fly away. Further, finding its way back to the hive depends on highly programmed learning. The bee appears to learn significant landmarks associated with the hive on the first departure each day. If the hive is moved a few feet from its original location, returning bees exhibit great confusion and disorientation. However, if the hive is moved several miles overnight, the bees have no problem in learning the new location and finding their way home, so long as it remains in the same place after the first departure of the day:

> Learning, for the bee, has thus become specialized to the extent that specific cues are learned only at specific times—and then only in specific contexts. In fact, the learning programs of bees are even more specialized than that: although the insects acquire each bit of knowledge separately and at a different rate, once acquired, their knowledge forms a part of a coherent and holistic set, that is, a unit that cannot be reduced to discrete component elements. (Gould, 1979:71)

Digging Wasps

The digger wasp also exhibits some rather extraordinary *instinctive* learning abilities. This particular wasp carefully prepares a burrow into which she deposits an insect or caterpillar that has been paralyzed by her sting. The wasp then deposits an egg on the host. When the egg hatches, the new larva feeds on the bee or caterpillar. One species of the digger wasp, *Ammophia pubescent*, exhibits incredible programmed learning and memory abilities. This particular wasp species provides provisions for as many as a dozen burrows containing young at various stages of development and nutritional needs. The wasp inspects each burrow and makes an inventory of what is needed for each larva. She then goes about the business of finding the required provisions. The Dutch ethologist G. P. Baerends (cited in Gould, 1982) found that the female wasp only retrieves the amount of food needed by each larva. Burrows containing an egg receive no caterpillars and small larva receive one to three caterpillars, whereas large larva receive more and pupating larva receive no food at all. By altering the contents of the various burrows while the wasp was out foraging, Baerends made a series of fascinating discoveries. If a burrow, for example, containing a large larva was excavated and replaced with a small larva or an egg, the wasp would provide it with the correct amount of food only if the alteration took place before the morning inspection. If the change was made after the morning inspection, the wasp would place an amount of food calculated from those morning observations, regardless of the actual needs of the larva placed into the burrow by the experimenter in her absence:

> During the morning inspection, Baerends reasoned, the wasps must make some sort of "shopping list," in which the detailed needs of each burrow are inscribed in association with its location and relevant landmark information. Working from her original shopping list the wasp, having learned more in a few minutes than many humans could—perhaps as many as

> forty-five items in sets of three—proceeds to organize the rest of her day as mindlessly as a machine. This sort of learning, then, phenomenal as it is, is as stereotyped as any other piece of insect behavior. (Gould, 1982:262)

The digger wasp is specialized to obtain and act upon specific information derived from the environment at certain times of the day. However, the nature of this information and the manner in which it is obtained is subject to encoded rules and rigid mechanisms of acquisition. Tinbergen (1951/1969) described an experiment in which 20 pine cones were arranged around a digger wasp's (*Philanthus triangulum*) burrow while she was still inside. As the wasp left her burrow, she took a 6-second aerial reckoning of the immediate surroundings before flying away. While she was gone, the experimenter rearranged the pine cones, placing them several feet away from the burrow. On her return, the wasp went directly to the pine-cone circle in search of her burrow. This experiment was repeated several times with the same disorienting result. The wasp was unable to find the location of her burrow until the pine cones were finally returned to the original place around the burrow.

Of course, the dog's style of learning is very different from that exhibited by the honeybee and wasp, yet it may be profitable to study such learning as a means of gaining insight into aspects of the learning process not made explicit by laboratory investigations. Although finding parallel examples of fixed program learning in dogs is not easy, the dog is clearly programmed to learn some things at certain times more rapidly than at other times. Fox (1966), for example, found that avoidance learning was most rapidly obtained during a short sensitive period between 8 and 10 weeks of age. Scott and Fuller (1965) found that social identity and many social behavior patterns are learned during a brief period running between 3 and 12 weeks of age. Tinbergen observed that some Greenland Eskimo dogs had their first copulatory experience, defended home territory, and avoided neighboring territories all within the course of 1 week. Prior to this time, the dogs ran roughshod over the territories of other packs, a behavior that resulted in severe and repeated reprisal. According to Tinbergen, it was as though the dogs simply could not get the idea: "They do not learn the territories' topography and for the observer their stupidity in this respect is amazing" (1951/1969:150). Thus, habits, appetites, and aversions are optimally acquired at specific times in a dog's ontogenesis, suggesting that efficient training and socialization is a process dependent on proper timing as much as proper training.

PREPAREDNESS AND SELECTIVE ASSOCIATION

Learning is a basic adaptive mechanism exhibited by the vast majority of animals. It plays a profound role in a dog's success or failure in adjusting to its social and physical surroundings. As noted above, learning takes place within a biobehavioral context formed of many unlearned, innate mechanisms that supply a dog from birth (and before) with a varied repertoire of reflexive and instinctive adjustments to the environment. All animals come into the world preadapted to sense and attend to a limited set of stimuli; predisposed to feel and respond to a select group of unconditioned stimuli with emotionally significant arousal; programmed to act within a fixed range of ways (albeit variably within that range); and prepared to learn certain things and select associations, but not all things are learned or associated with an equal ease (Seligman, 1970). For example, although puppies can easily master the house-training routine, another animal like the chimpanzee, although considered by ethologists to be much more intelligent than the dog, may require laborious efforts to achieve voluntary control over alimentary functions—if at all. The chimp's evolutionary niche has placed little selective pressure on such variability in its elimination habits. The preparedness hypothesis suggests that certain conditioned stimuli and unconditioned stimuli are more readily associated than others, and, in the case of instrumental learning, the connection between a particular response and its consequences is more rapidly learned than others.

Preparedness affects dogs in both beneficial and adverse directions. Many phobic and emotional reactions are innately programmed and readied for potentiating experience (Seligman, 1971; LoLordo and Droungas, 1989). Dogs are prepared to enjoy close social contact with conspecifics and human companions but are unprepared to cope with loneliness and extended periods of separation. They are prepared to adjust socially within a highly structured and regimented social order but may become socially confused and overly competitive within an environment lacking the presence of a dominant figure modulating such competitive tendencies. The dog's sensory capabilities, like other animals, are attuned to a narrow field of species-typical activity. Not only must dogs be able to differentiate relevant from irrelevant information impinging on their senses, they must also be able to isolate it from competing background stimulation, attend to the specifics over time, and organize the information into meaningful associations from which to assess its significance and to decide on a course of effective action. Many of these functions occur more or less automatically by virtue of the way information is obtained and processed in the animal's brain.

Sensory Preparedness

Organisms are biologically prepared to selectively attend and respond to stimuli, depending on an apparent innate recognition of their significance. For example, Tinbergen (1951/1969) observed that young ducks and geese selectively respond to a cardboard silhouette depending on its orientation and direction of movement. When the model was moved to the right, it had the appearance of a short neck and long tail or hawklike attributes that evoked strong escape reactions. On the other hand, when the model was moved toward the left, it had the appearance of a long neck and short tail, i.e., the attributes of a goose in flight. This latter presentation evoked no response in the birds tested. Tinbergen also theorized that predators develop a *search image formation* in order to locate difficult-to-find prey animals equipped with *antipredator* adaptations (Fantino and Logan, 1979). Through experience involving successful hunts, the animal learns what to look for that is specific to the camouflaged or hidden prey animal. Gradually, the predator learns to attend to these specific attributes when searching for food.

Although not experimentally demonstrated in the laboratory, dogs appear to be more alert and attentive to the presence of accelerating (slow to fast) movements as opposed to decelerating (fast to slow) ones. Accelerating movements may be innate *sign stimuli* for escape/withdrawal behavior. Under natural conditions, slow-to-fast movements are more often associated with danger (e.g., a falling rock, swooping hawk, or stalk-and-chase movements of predators), certainly more so than movements exhibiting a fast-to-slow pattern (e.g., retreat). These opposing patterns of motion may be recognized by the distinctive patterns of retinal stimulation they produce. Command cues spoken with a clipped slow-to-fast inflection are typically much more effective than commands spoken in a drawn-out fast-to-slow manner. Similarly, strange and loud noises attract more attention than familiar and quiet sounds.

Dog trainers and owners alike have long recognized the value of altering the tone and amplitude of the voice to influence a dog's behavior. Repeated "kiss" sounds and whistles are familiar ways to stimulate a dog's attention and to arouse action. Similarly, soft and drawn-out word tones are commonly used to calm an agitated dog, whereas abrupt and repeated verbal prompts may be used to alert and put a dog on guard. Although dogs may not be able to understand the precise conceptual meaning and intent of the words used to communicate with them, they are very keen and responsive to the manner in which the words are spoken. For example, saying "No" in a high-pitched and upbeat tone of voice will likely evoke in a dog a preparatory response in anticipation of a rewarding outcome rather than worrying the dog about the possibility of impending punishment. Of course, in this example, classical conditioning probably plays an important role in the elaboration of the dog's response. However, it

does appear that high and gentle tones of voice are more easily associated with rewarding outcomes, whereas low and forceful tones are more rapidly connected with punitive ones. Clearly, the tone and other characteristics of auditory stimulation appear to influence how dogs interpret information conveyed by verbal communication. Tone of voice conveys information to dogs about a trainer's emotional state and his or her immediate intentions, much like whining and growling convey very specific and different intentions among dogs. In other words, the meaning of the word signal appears to be most dependent on the *way* it is asserted rather than any abstract meanings conveyed by the word itself.

These observations suggest that dogs exhibit some degree of innate responsiveness to auditory stimulation based on the qualitative or quantitative characteristics of the acoustic signal presented. Clearly, socially significant auditory signals utilize various means to shape and infuse intentional meaning into the signals used to communicate needs. Patricia McConnell has explored the possibility that various physical alterations of acoustic stimuli may elicit differential changes in a dog's general activity level. Her investigation into this phenomenon began by interviewing over 100 trainers from all over the world (McConnell, 1990b). She found that the general style of auditory signaling used by animal trainers shared a fairly universal and definite pattern. The vast majority of trainers used rapidly repeated auditory signals to excite activity, whereas they used long and drawn-out signals to inhibit activity. Besides vocal sounds and whistles, she found that most trainers used repeated hand claps, finger snaps, tongue clucks and clicks, leg slaps, or "lip smooches" to increase activity in dogs. According to her interview records, no trainer ever mentioned using such signals to inhibit behavior. She observed that animal trainers would often give one sort of signal (e.g., two brief whistle blasts) to direct a dog into some action and then rapidly repeat the same sound to speed up the desired response. In one study comparing the effects of various signals on the approach behavior of puppies, McConnell found that the strongest approach response toward a hidden person was evoked by repeated hand claps.

As a result of these interviews and related observations, she hypothesized that short and repeated ascending tones tend to stimulate behavioral excitation, whereas long and descending tones tend to exert an inhibitory effect over behavior. To test this hypothesis, she raised a mixed group of 20 Border collie and beagle puppies, carefully avoiding the use of expressive tones of voice, finger snaps, whistles, and claps (McConnell, 1990a, 1992). Only quiet and monotonic speech was permitted around the puppies, with most control being exercised by employing visual signals. At 4 months of age, 14 of the puppies were divided into two groups that received training to come or sit-stay on signal. Group 1 was trained to come in response to four brief ascending tones (150 milliseconds at 1500 Hz ascending to 3500 Hz) and to stay in response to one continuous descending tone (750 milliseconds at 3500 Hz descending to 1500 Hz). Conversely, group 2 was trained to come or stay in response to the same signals used to train group 1, but in reverse—that is, the continuous descending tone was associated with coming, whereas the repeated ascending tone was used to signal puppies to stay. After 10 days of training, the signals presented to the two groups were reversed. Although an apparent trend toward more efficient acquisition and increased activity was evident in group 1 (i.e., when "come" training was carried out in the presence of the repeated ascending tone), the overall effects of the training arrangement reached statistical significance only after the two groups were retrained to respond to the opposite set of signals. Even so, the significance detected by the study was not based on acquisition measures per se but rather stemmed from the elicitation of increased activity levels (viz., forepaw steps) occurring as the result of the presentation of the repeated ascending tone. Unfortunately, the study failed to show a significant differentiation between the two signals with respect to stay training and the acoustic inhibition of behavior. Overall, the results are somewhat disappointing and in-

conclusive with regard to the existence of an innate acoustic mechanism differentially sensitive to repeated and continuous signals—at least in the form used in the study. In the case of puppies, the differential effects of the signals presented show a definite trend consistent with McConnell's hypothesis; however, the results fail to demonstrate a very robust effect. Further, some effort should have been made to isolate potentially confounding influences differentially exerted by ascending versus descending tones on the behavioral effects attributed to repeated versus continuous signals. This would have required the incorporation of additional compound stimulus test arrangements such as repeated-descending versus continuous-ascending groups, with which to compare any additive or subtractive influences of tonal direction on activity in the presence of continuous or repeated signals.

From these findings, it appears that dogs are biologically prepared to increase nonspecific activity in response to brief and repeated acoustic signals. Although McConnell's study does not show a corresponding behavioral inhibition resulting from the presentation of long and continuous signals, it is clear from common experience that long and continuous signals do exert a calming and inhibitory effect on a dog's behavior. Many situations in nature attest to the activational effect of repeated tones, ranging from distress vocalizations in puppies to mating calls in birds. McConnell speculates that the dog's responsiveness to ascending repetitious sounds may be related to species-typical distress vocalizations, including whining, yelping, other repetitive sounds associated with intense arousal and care-seeking activity. Agonistic behavior may also provide an innate basis for the differential elicitation of increased activity versus decreased activity in response to acoustic stimulation of differing duration and tonal direction. A comparison of rapid alarm barking versus slow and continuous growling reveals distinctive innate features and effects. Rapid alarm barking serves to attract the attention and excitement of nearby conspecifics, alerting them and, perhaps, mobilizing them to join in and participate—that is, it has an excitatory effect on the group. On the other hand, growling (a long, continuous social signal) may certainly attract the attention of the recipient, but it is more likely to elicit an inhibitory effect or result in the slow withdrawal or immobilization of the recipient target.

Cognitive Preparedness

The influence of behavioral preparedness should be given careful consideration when designing programs for modifying canine behavior. Dogs learn to perform some actions more rapidly or slowly, depending on the biobehavioral compatibility of the signal used and the behavior required to occur in the presence of that signal. Some signals and responses are more easily associated than others. For example, Lawicka (1964; Dobrzecka et al., 1966) found that dogs prefer spatially lateralized discriminative signals when learning a directional discrimination (go left/go right), while go/no go discriminations are more easily acquired when the discriminative cues are presented from the same location but varied in terms of tonal quality (Fig. 5.2). For example, in a simple go left/go right discrimination experiment, he found that dogs could learn the directional discrimination only if the discriminative tonal cues (high and low pitch) were presented from different locations relative to dogs. Although directional discriminations depend on spatially separated signals, such learning does not depend on the lateralization of the signals on a left-right axis. In fact, he demonstrated that dogs could learn to discriminate the correct left or right direction even if the signals were presented along a vertical axis, that is, by placing one sound source above the other. However, if the two signals were presented from the same location (a single speaker), then the go left/go right discrimination was frustrated and learned only with much difficulty, if at all. In another experiment, he found that dogs learned a go/no go discrimination much more easily if the discriminative cues came from the same source but varied in terms of tone. If the tonal signals were lateralized relative to the dogs, then the go/no go discrimination was impeded. Lawicka's exper-

STIMULUS

	Low Tone	Above
	High Tone	Below
	Speaker facing front	Speaker placed above or below dog
	QUALITY	LOCATION
RESPONSE: GO/NO GO	Rapid Acquisition	Slow Acquisition
RESPONSE: GO LEFT/ GO RIGHT	Slow Acquisition	Rapid Acquisition

FIG. 5.2. Matrix shows the various relations tested in the Lawicka experiment. Note that acquisition rates differ depending on the sort of response being learned and the type of stimulus presented. After Miller and Bowe (1982).

iments clearly show that dogs are prepared to learn directional discriminations with spatially separated signals and go/no go discriminations from signals varied in tone but coming from the same location.

Prepared Connections: Taste Aversion

Another interesting study often discussed in the context of preparedness was performed by Garcia and Koelling (1966). Two groups of rats were given either water having a sweet taste (saccharine flavor) or water presented together with a compound audiovisual (light and noise) stimulus. These two groups were divided and differentially exposed to radiation or shock while they drank the water. The investigators found that radiation was selectively associated with the sweet water but not with the bright-noisy audiovisual stimulus. After exposure, radiated rats avoided sweet water but continued to drink bright-noisy water. In the case of rats exposed to shock while drinking, the bright-noisy stimulus was selectively associated with shock, but shock was not associated with the sweet water. After exposure to shock, the rats would avoid bright-noisy water but continued to drink sweet water (Fig. 5.3). These experiments suggest that rats are biologically prepared to associate taste with nausea and, likewise, to associate light-noise with shock, but unprepared to make the converse associations, that is, to associate taste with shock or light-noise with nausea.

Additional evidence for biological preparedness in taste aversion was provided by a study performed by Wilcoxin and colleagues

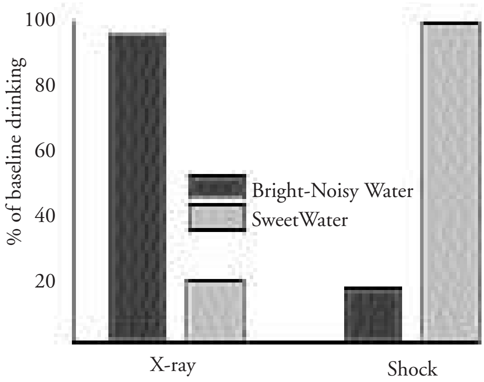

FIG. 5.3. This Garcia and Koelling (1966) study demonstrates the principle of selective association. The animals studied selectively associated nausea with sweetness and shock with auditory and visual stimuli, but not vice versa.

(1971), who compared the differential acquisition of taste aversion in rats and quail. The subjects were variously presented with water having a sour taste, water colored dark blue, or water that was both sour and dark blue. Rats experiencing nausea after drinking these combinations of color and flavor responded to flavor cues but not visual cues. Quail, on the other hand, were able to associate either the color or the taste of the water with nausea, provided the cues were presented separately; however, if both taste and color were presented together, the color cue overshadowed the flavor cue. When later offered sour or colored water, the quail drank sour water but not colored water. An obvious conclusion to be drawn from this experiment is that quail are prepared to make the taste-aversion association more effectively through the modality of sight than taste, whereas rats are better prepared to acquire a taste aversion through the modality of gustation only.

Many animal species are programmed to wait for some fixed period after ingesting a new food item in order to determine whether it is toxic to them (Gould, 1982). A blue jay, for example, hunts and eats butterflies, but if it happens to eat a monarch butterfly, it will soon become ill and vomit. Illness is induced by cardiac glycosides stored in various parts of the butterfly's body. These substances are obtained by the butterfly larva feeding on the milkweed. After a single exposure to the nausea-producing monarch butterfly, a blue jay will avoid hunting them in the future (Brower, 1969). The most significant avoidance cue for blue jays is the butterfly's colorful wing pattern. Interestingly, the monarch butterfly's wing color and pattern has been mimicked by other butterflies (most notably, the viceroy butterfly), ostensibly providing them with safety from previously "trained" blue jays. Gould (1982) contends that taste aversion or "rapid food-avoidance conditioning" is a widely distributed form of programmed learning in the animal world. Each species is responsive to a specific set of cues that identify the most salient feature or sign stimulus associated with the evocation of illness. Tinbergen describes other cases involving learned food avoidance and mimicry. Songbirds exhibit a learned avoidance toward wasps due to illness induced by eating them:

> When a songbird such as a Redstart meets with a wasp for the first time in its life, it captures it. Sometimes, but that is relatively rare, the wasp will manage to sting the bird. The bird then lets go, and may show in various ways that the sting affected it rather unpleasantly; it may shake its head, and wipe its bill. Anyway it shows no further interest in the wasp. Usually however the wasp does not sting, it is killed before it can do so. Then it becomes evident that a wasp is distasteful: the bird does not finish it, and if it is eaten, it is often brought up again afterwards. Mostler has shown that most songbirds learn from one or a few such experiences to leave wasps alone. That they recognize such unpalatable insects by their colours is evident from the fact that from then on such a bird avoids not only wasps, but all similarly coloured insects. (1953/1975:95–96)

Many birds exhibit a similar avoidance toward the caterpillar of the cinnabar moth. After a single ingestion, birds learn to refuse all larvae with the caterpillar's distinctive black-and-yellow pattern of marking.

Studies with wild canids have demonstrated that taste aversion can be effectively employed to deter appetitive interest toward highly desirable prey animals. Coyotes have been conditioned to avoid sheep after being exposed to mutton and wool tainted with

lithium chloride (LiCl) (Gustavson et al., 1974). Presumably, these treated coyotes had some previous safe exposure to the prey in the past. Besides coyotes, many other animals have shown a similar response to the taste-aversion procedure (Garcia et al., 1977; Gustavson, 1977). Mugford (1977) demonstrated that a strong taste aversion toward a highly palatable food item could be produced in cats if ingestion of the food was followed by treatment with LiCl. Gustavson and Gustavson (1982) compared the suppressive effects of peripheral versus internal aversive stimuli (nausea) presented at different points during the feeding sequence—that is, while rats approached or after they had consumed a highly desirable food item (an Oreo cookie). The peripheral stimuli included shock and repellents (ammonia, mustard, and quinine). Nausea produced by LiCl injections provided the internal aversive stimulation (taste aversion). They examined the suppressive effects of these aversives across three contexts: treatment cage, home cage, and novel cage (Table 5.1). Only taste aversion was shown to increase the latency of approach in all three training situations but only if the rats had consumed some of the cookie prior to the induction of nausea. Rats shocked as they approached the cookie exhibited significant hesitation when later tested in the treatment cage, but showed little evidence of transfer of suppression when tested in the home-cage and novel-cage situations. Interestingly, consumption measures indicated that rats exposed to quinine and mustard ate more of the cookie when it was presented in the home cage. Rats exposed to ammonia while they were eating exhibited significantly more hesitation when given a cookie in the novel test situation. A similar suppressive effect in the novel situation was not produced by quinine or mustard. In general, these findings suggest that aversion training using peripheral stimulation tends to be more context specific, whereas flavor-associated aversive internal stimulation (nausea) has cross-contextual implications: the suppression of appetitive and consummatory behavior. The authors illustrate the effect:

TABLE 5.1. Comparison of peripheral versus internal aversive conditioning

Training phase							
APPROACH GROUP—Aversive stimulation presented as the animal approached the cookie							
Testing phase		No stimulus	Shock	Ammonia	Mustard	Quinine	LiCl
Testing Contexts	Treatment	+	hes +	+	+	+	+
	Home	+	+	+	+	+	+
	Novel	+	+	+	+	+	+
Training Phase							
CONSUMPTION GROUP—Aversive stimulation presented as the animal ate the cookie							
Testing phase		No stimulus	Shock	Ammonia	Mustard	Quinine	LiCl
Testing Contexts	Treatment	+	hes +	+	+	+	000
	Home	+	+	+	++	++	000
	Novel	+	+	hes +	+	+	000
Key	+ Ate	++ Ate more	hes + Hesitated before eating		000 Did not eat		

Note: The conditioned effects of peripheral and internal aversive stimulation occurring in different contexts. Note that only LiCl-induced nausea produced appetitive avoidance in all three testing situations.
Source: After Gustavson (1996).

> Conditioned taste aversions alter the palatability of the food, and make the flavor unacceptable whenever or wherever it is encountered. ... Anecdotally, if one wants to prevent a dog from eating biscuits in the parlor, but allow the dog to eat them in the yard, a peripheral aversive stimulus should be repeatedly applied to the animal when it approaches the biscuits in the parlor, but it should never be applied in the yard. However, if the desired impact is to prevent the eating of biscuits under any circumstances, then the dog should be made ill following consumption of biscuits on one or two occasions. (Gustavson and Gustavson, 1982:339)

While I cannot imagine anyone being so annoyed by a dog's interest in biscuits that they would want to apply a taste-aversion procedure to discourage it, the foregoing technique might be useful for the control of appetitive excesses of a more serious nature, such as intractable pica or coprophagia (Gustavson, 1996).

Efforts to test the suitability of taste aversion for the control of predatory behavior in dogs have not met with the success that might be expected from the aforementioned studies with wild canids and rodents. Hansen and colleagues (1997) treated two Alaskan huskies that exhibited a strong drive to chase and attack sheep; however, (apparently) neither of the dogs had actually killed or eaten sheep as prey in the past. The study consisted of feeding the dogs mutton mixed with wool and fat that had been tainted with LiCl. Although the dogs developed an aversion toward sheep meat, it was neither permanent (within 6 months, the dogs readily ate mutton) nor was it effective as a means to reduce the dogs' predatory behavior. In fact, the authors found that the procedure actually decreased the latency of predatory chase/attack behavior rather than increasing it as they had anticipated. They also noted several side effects, including an increase in intraspecific aggression, stiffness, trembling, and coordination deficits resulting from the ingestion of LiCl. A possible explanation for the study's failure to demonstrate a positive effect resulting from taste aversion may be due to the absence of a history of predatory behavior toward sheep that had resulted in the ingestion of sheep meat. The dogs apparently did not associate the chase routine and the target prey with the meat they had developed an aversion toward. Further, since the authors were unclear about the predatory history of the dogs tested, one cannot be certain that the behavior of "chasing and attacking" was strictly motivated by predatory interests and the obtainment of food. For example, the dogs may have been engaging in predatory play, having no interest in eating their victims. Perhaps, better results with the taste-aversion method for controlling predatory behavior in domestic dogs would be obtained in cases that involve dogs who do exhibit a strong appetite for killing and eating the target prey animal.

Phylogenetic Differences: Habit Reversal and Matching

Bitterman (1965) compared the performance of various species learning the same tasks, that is, two discrimination procedures: habit reversal and matching. Habit reversal is a two-choice discrimination procedure where a previously conditioned positive stimulus S^D is made negative and a previously conditioned negative stimulus S^Δ is made positive. Bitterman found that some species (e.g., monkeys, rats, pigeons, and turtles) learn this sort of discrimination quickly, whereas others (e.g., fish, cockroaches, and earthworms) acquire the habit reversal poorly—if at all. The other task studied examined probability learning and matching behavior. The matching procedure involves presenting two discriminative stimuli in a choice situation. In an ordinary two-choice discrimination situation, reinforcement is associated 100% of the time with the positive stimulus and 0% of the time with the negative stimulus for a probability ratio holding between the two stimuli and reinforcement of 100:0. When reinforcement is presented so that, for example, 70% of the available reinforcement occurs in the presence of one stimulus (S^D1) and the remaining 30% occurs under the signalization of another (S^D2), some animals will tend to maximize by exclusively choosing only the stimulus with the highest likelihood of producing food (S^D1-70:S^D2-0), whereas other animals will tend to match their behavior—

that is, they tend to divide their time proportionately between the two stimuli (S^D1-70:S^D2-30). Surprisingly, Bitterman found that rats tend to maximize, whereas fish tend to match. This is a rather counterintuitive finding, since one would expect the "brainier" rats to "figure out" the probabilities of reinforcement more accurately than fish would and then to proportion their responses according to these probabilities. In fact, however, he discovered that decorticated rats performed the visual matching task better than normal controls, suggesting that the substrate locus of such matching behavior is at a subcortical level. Bitterman speculated that these differences in learning are phylogenetically significant and pertain to an animal's specific needs and adaptations within its respective evolutionary niche and ecological environment.

INSTINCTIVE DRIFT AND APPETITIVE LEARNING

Just as innate defensive reactions often obstruct efficient avoidance learning, interfering appetitive and exploratory tendencies sometimes surface during reward training that can significantly impede positive learning (Bolles, 1972). Animals trained to perform simple chains of behavior for food reinforcement often spontaneously exhibit adjunctive behavior patterns that distract them from completing the trained sequence. This interference occurs in spite of intensive and lengthy training efforts. In fact, it appears as though such interference worsens as conditioning proceeds. Animal trainers (Breland and Breland, 1961) using operant conditioning to train a variety of species to perform for entertainment and commercial purposes found that a number of the tasks were interfered with by species-specific appetitive and exploratory behaviors that spontaneously appear during the course of training. These interference effects resulting from food reinforcement are collectively referred to as *instinctive drift.* For example, in one case, a pig was trained to pick up wooden coins with its mouth and to deposit them in a piggy bank. The pig readily learned the task but over time began to play with the coins by repeatedly picking them up and dropping them down again, throwing them into the air, or rooting them about with its snout—all behaviors associated with normal pig exploratory and appetitive behavior. Similarly, raccoons that had been taught a similar task would persistently fondle the coins before dropping them into the bank or, perhaps, periodically dip the coin into the bank as though washing it. When provided with more than one coin at a time, the raccoons would tend to rub them together instead of dropping them into the box as they had been trained to do. The Brelands formulated the following conclusion regarding instinctive drift:

> The general principle seems to be that wherever an animal has strong instinctive behaviors in the area of the conditioned response, after continued running the organism will drift toward the instinctive behavior to the detriment of the conditioned behavior and even to the delay or preclusion of the reinforcement. In a very boiled-down, simplified form, it might be stated as "learned behavior drifts toward instinctive behavior." (1961:684)

It is interesting to note that the sensory-motor modalities involved in this phenomenon are consistent with an interpretation involving corticothalamic dominance previously discussed (see Chapter 3). Under Welker's (1973) model of thalamocortical dominance, pigs are *rooters*, raccoons are *feelers*, and pigeons are *beholders*. Furthermore, some self-reinforcement stemming from hypothalamic-limbic feedback occurring during the emission of appetitive behavior may help to explain instinctive drift while at the same time preserving reinforcement theory. The locus of reinforcement supporting instinctive drift is internally articulated on brain reward sites associated with drive induction and preparatory appetitive responding. The arbitrary operant, on the other hand, may be more adequately conceptualized as belonging to or conditionally associated with the consummatory action and subsequent drive reduction. Although both are reinforcing, the action of preparing to eat may be intrinsically more rewarding than eating itself. Motivationally, this makes a lot of sense, since it

requires a lot more effort (therefore, a lot more incentive and conditional reinforcement prior to consumption) to find food than to eat it.

Many other problems with the traditional conceptualization of appetitive operant learning have emerged in the laboratory. Brown and Jenkins (1968) discovered that pigeons could learn the key-peck response without being trained to do so by the experimenter. They found that pigeons readily acquired the habit of key pecking by simply exposing the birds to an active key that was programmed to light for 8 seconds and then shut off just before the presentation of food. The process, known as *autoshaping*, has drawn a great deal of attention, since it implies that the key-peck response may not be, strictly speaking, an operant at all but rather an elicited response acquired without depending on contingent positive reinforcement. It should be noted that while the initial key-peck response was not shaped or prompted, subsequent pecks at the lighted key were linked with the lighted key (conditioned reinforcement) and the presentation of food (i.e., positive reinforcement). The explanation for autoshaping may simply rest on the pigeon's high operant level for pecking and the occurrence of incidental reinforcement (i.e., superstitious learning). Seligman (1970) speculated that the autoshaping phenomenon depends on a high degree of preparedness in pigeons to associate pecking with the acquisition of food.

Subsequent experiments have yielded results that are even more difficult to explain by resorting to reinforcement theory. Williams and Williams (1969) designed an experiment in which key pecking never resulted in the acquisition of food but actually postponed it, that is, the bird was punished for pecking. Despite the negative punishment contingency, the pigeons maintained the key-peck response at a low rate (responding in one-third of the trials) and persisted in performing the response over the course of several hundred trials without stopping—even though the effort resulted in the omission of reinforcement. This finding is consistent with the observations of Breland and Breland. In effect, animals that are learning a response closely linked with an innate appetitive-consummatory action tend to *drift* into its performance despite apparent reinforcement contingencies. The appetitive-consummatory action itself overshadows the arbitrary operant being rewarded. Jenkins and Moore (1973) observed that pigeons autoshaped to peck at a key for water or grain exhibited distinctively different response topographies. Pigeons trained to peck for grain exhibited a response resembling that used during eating, whereas those trained to peck for water did so in a manner topographically similar to drinking. This has led to some speculation that what is being learned is not an operant at all but rather a classically conditioned consummatory response.

While key pecking is rapidly acquired during appetitive training, not all responses are equally easy to shape. For instance, teaching dogs to scratch, yawn, or lift the rear leg in the typical urination posture is very difficult. Thorndike (1911/1965) found that cats worked much harder to escape problem boxes than did dogs. Many dogs would simply accept confinement in the box and not make the requisite effort to escape and obtain the proffered food reward. Thorndike noted that dogs tended to remain in the front of the box, fixed attentively on the food that remained out of reach. Unlike the cat, the dog "wants to get to the food, not out of the box" (1911/1965:59). Even among general obedience exercises, some behaviors are learned more easily than others. While the average dog readily learns to sit in exchange for a treat, many dogs "resent" being prompted to lay down and may actively resist such training efforts, even when it is carried out with food rewards alone.

Contrafreeloading

Another troubling exception to the predictions of classical reinforcement theory is a phenomenon known as *contrafreeloading* (CFL). Neuringer (1969), for example, seriously questioned the importance of deprivation in animal studies, suggesting from his investigation of CFL that animals will work regardless of their motivational state (e.g.,

presence of threat or deprivation), even in the presence of free food. Several other studies have shown that animals will work under certain conditions for food doled out on a contingency basis, even though identical food is readily available in abundant quantities for free [Jensen (1963); also, see Osborne's review (1977)]. Many researchers studying CFL have suggested that the phenomenon reflects a preference for reinforcement with stimulus change or conditioned reinforcement over food presented ad libitum without stimulus change.

Inglis and coworkers (1997) offered another possible interpretation of this odd behavior, suggesting that CFL might serve an adaptation-enhancing function by providing information about a less than optimal food source. According to this theory, rather than exploit the immediately present, but possibly temporary, source of food, the animal works for food on a contingency basis to learn more about how to best manage and control (optimize) a potentially more reliable food source. Studies involving response-produced stimulus change seem to support such an informational purpose or imperative driving CFL (Wallace et al., 1973; Osborne and Shelby, 1975). CFL is especially interesting since it suggests that learning does not depend exclusively on consummatory events, but rather appetitive learning (at least) includes informational incentives that occur before the presentation of food.

Another possibility underlying CFL is the potentiating effects of conditioned reinforcement on learned behavior. For example, Marx and Murphy (1961) trained two groups of rats to nose poke for reinforcement. One group was exposed to classical conditioning where a buzzer was presented just before the presentation of reinforcement. Afterward, the two groups of rats were trained to run an alleyway. After a bit of practice, the two groups were exposed to the buzzer in the start box. The researchers found that the rats previously conditioned to the buzzer ran much faster than the controls. Stimulus change in this situation may be interpreted as an expectancy effect that augments general arousal and speed of performance. Expectancy as an information incentive makes sense here and in the case of CFL as well.

In several respects, CFL mirrors instinctive drift, except in one very important way—that is, CFL does not depend on a food-producing response for its maintenance. In fact, if stimulus change is discontinued and the target food-producing response is followed by the reinforcer only, the animals studied almost immediately neglect the food-producing response and turn instead to the free food now presented with antecedent stimulus change (Wallace et al., 1973). In the case of instinctive drift, the object cue associated with reward becomes the target of excessive behavior—for example, the raccoon's habit of repeatedly handling or "pretending" to wash the wooden coins and, consequently, failing to deposit them in the toy bank as required for reinforcement. Tomie (1996) reviewed a large body of literature showing that the manipulandum takes on special properties when it serves both as a reward cue and a mechanism for instrumental manipulation. According to this analysis, instinctive drift (a topic that he discusses at some length) is the result of a maladaptive repetition of preparatory responses that preclude actual completion of the sequence to obtain and consume primary reinforcement. Excessive manipulation of the cue/manipulandum may be a model for understanding some forms of compulsive behavior and drug abuse. Tomie, for example, argues that addictive behavior is driven to a considerable extent by the coincidence of the reward cue and the manipulandum (e.g., handling the syringe or holding and puffing the cigarette) occurring immediately prior to the pleasurable effects of the drug's action. The syringe or cigarette itself is implicated as playing an important role in the maintenance of the addiction.

GENETIC PREDISPOSITION AND TEMPERAMENT

Each individual—human or animal—is born with a definite tendency toward varying degrees of emotional reactivity in the direction of behavioral inhibition or excitability (Gray, 1991; Kagan and Snidman, 1991). The dog's

general emotional reactivity or threshold to emotionally evocative stimulation is definitely a predisposing factor in the development of many common behavior problems. To a large extent, differences in emotional thresholds are affected by a limbic/autonomic inheritance present at birth. Some individuals are genetically disposed to being more calm and emotionally balanced under the influence of limbic modulation and parasympathetic tone (parasympathetic dominant), whereas others (sympathetic dominant) are much more sensitive and reactive to fright-freeze-fight stimulation, are hyperemotional, tend to perseverate in negative emotional states, are subject to neurotic elaborations and disequilibrium, and are prone to develop psychosomatic disease.

Schneirla (1965) has proposed that approach-withdrawal patterns are the fundamental organizing components regulating animal behavior and emotional development. These opposed tendencies are integrated at the level of the autonomic nervous system. Approach behavior is evoked by low-intensity stimulation and is closely paralleled by parasympathetic activity, that is, steady-state biological functions like resting heart rate and respiration. On the other hand, withdrawal is evoked by high-intensity stimulation, paralleling the activation the sympathetic system and the elicitation of various states of biological readiness, like increased heart rate and respiration. Thresholds for approach behavior and withdrawal behavior are ontogenetically defined, with approach behavior being dominate during neonatal developmental stages and withdrawal tendencies like fear and defensive reactions becoming progressively more dominant as a dog develops (see Chapter 2).

With maturation, these various autonomic adjustments move toward homeostatic balance and set the dog's relative emotional reactivity as an adult. As a result, some individuals are more emotionally labile, whereas others tend toward emotional stability and calmness. Approach-withdrawal dynamics are regulated according to various threshold differences—differences that are influenced by a dog's genetic constitution and early experiences. As development progresses, primitive approach behavior becomes transformed into "seeking" or appetitive behavior (modified through the incentives of positive reinforcement), while withdrawal is elaborated into various learned patterns of escape and avoidance behavior (modified through the incentives of negative reinforcement). In domestic dogs, approach behavior is perpetuated so that competing withdrawal tendencies (flight, freeze, or fight) are kept in check. In some dogs, as the result of genetic disorders or adverse experiences, withdrawal thresholds are lowered and flight-fight reactions amplified, thus making the dogs more fearful or aggressively reactive to social contact.

As previously discussed (see Chapter 3), an important neural locus of emotional behavior is the hypothalamus, a brain structure orchestrating parasympathetic and sympathetic nervous activity. Besides regulating the expression of emotion, the hypothalamus has direct neural and hormonal connections with the pituitary gland, a structure responsible for the release of various tropic hormones, including adrenocorticotropic hormone (ACTH). The hypothalamic-pituitary-adrenal (HPA) system is a complex loop of biochemical feedback mechanisms regulating the body's reaction to stress and threat. ACTH stimulates the adrenal cortex to secrete various steroidal hormones, including cortisol, a hormone serving many general emergency functions as well as instructing the pituitary to stop producing ACTH. Additionally, the hypothalamus innervates the adrenal medulla, which, under sympathetic arousal, releases epinephrine directly into the bloodstream to support sustained emergency action.

The hypothalamus also appears to play a role in the regulation of androgen secretions. A negative-feedback mechanism exists between the level of testosterone in the blood and the hypothalamus (Hart, 1985). If the level of testosterone declines, the hypothalamus is stimulated to secrete gonadotropin-releasing factor, thereby causing the anterior pituitary to release luteinizing hormone into the bloodstream. Luteinizing hormone in male dogs stimulates the testes to produce increased amounts of testosterone. As testos-

terone reaches optimal plasma levels, the hypothalamus ceases the production of the releasing factor, which causes the pituitary to stop producing luteinizing hormone. Gonadal hormones appear to play a significant, although variable, role in determining a dog's general temperament by modulating thresholds for the expression of various sexually dimorphic and species-typical behavior patterns. Perinatal and pubescent androgens may predispose male dogs to exhibit a wider variety and greater frequency of behavior problems than exhibited by females as adults (Hart and Hart, 1985). In general, the effect of androgens on behavior is twofold: (1) the androgenization of testosterone-sensitive neural substrates mediating sexual and aggressive behavior (perinatal), and (2) modulating activities in these substrates once they are elaborated and functioning (pubescent).

Because of the apparent role of testosterone in the expression of certain forms of aggression, neutering is often recommended as a method for controlling such behavior. However, a great deal of controversy surrounds the effects of castration on aggressive behavior in dogs. Although castration appears to reduce intermale aggressive behavior in many mammalian species, the effect of castration is not so dramatic or clear-cut among dogs. Le Boeuf, for example, compared the adult behavior of dogs castrated at 40 days of age with the behavior of intact littermates. He found that prepubertal castration "seems to have little effect on sexual responsiveness, sexual attractiveness, or aggressivity" (1970:134). Similarly, Salmeri and colleagues (1991) found that prepubertal neutering (7 weeks of age) produced little difference in comparison with conspecifics neutered at 7 months. Surprisingly, the only dimensions of significant behavioral change resulting from prepubertal neutering were excitability and general activity levels but moving in an opposite direction than expected. They found that castrated dogs tended to become *more* active and excitable than intact controls. Even intermale aggression was only modestly decreased. Other studies have shown more dramatic effects resulting from neutering (Hopkins et al., 1976; Neilson et al., 1997). These studies involved populations of dogs exhibiting various behavior problems at the time of castration. The results indicate that the behaviors most likely to be affected by neutering are those associated with sexual maturation—that is, those depending on the presence of circulating testosterone for their full expression or maintenance.

A possible cause for the variable effect of castration on sexual behavior and aggression may be due, in part, to the influence of perinatal androgenization. The puppy's nervous system is androgenized just before birth and after birth by a surge of testosterone, thus predisposing the dog to exhibit many sexually dimorphic physical and behavioral characteristics as an adult male. Another surge of testosterone occurs at the time of puberty beginning around 6 months of age, reinforcing and sensitizing the earlier androgen effects on neural tissue. Evidence from studies with mice and rats suggests that prenatal secretion of testosterone may also affect the development of female fetuses that happen to be situated between males in the uterus. Such androgenized female rodents tend to exhibit more malelike behavior and aggressive tendencies as adults (Knol and Egberink-Alink, 1989). These effects have been demonstrated in other species (e.g., ungulates) and, at least theoretically, are possible in dogs (Overall, 1997). In fact, Coppola (1986, reported in Borchelt and Voith, 1996) has found that female dogs born in litters predominantly composed of male puppies are more likely to exhibit dominance aggression and various masculine tendencies as adults. Another potential source of prenatal influence on the emotional reactivity of offspring is the effect of anxious stress on the mother. Thompson (1957) performed a carefully controlled study in which rat mothers were differentially exposed to stressful stimulation versus normal laboratory conditions over the period of gestation. Subsequent tests revealed that the young of stressed mothers were significantly more "emotional" than controls born to unstressed mothers.

Obviously, many contributing factors affect the emotional reactivity of dogs. Scott notes that while susceptibility to emotionally

provocative stimulation is undoubtedly subject to genetic variation, emotion per se does not exist on a genetic level:

> Emotions do not exist in genetic systems but are created as a result of the organizing activity of genetic systems interacting with other systems in the processes of development. There is no "gene for" an emotion or emotionality; these are phenomena that exist only on higher levels of organization. (1988:22)

He goes on to propose that the general function of emotion is to prolong momentary stimulation. The prolongation of emotional arousal motivates purposeful behavior in the direction of satisfying the emotional demand. The various emotions experienced by an animal are the motivational forces facilitating both adaptive and maladaptive behavior. In the case of maladaptive behavior, highly charged emotional reactions contribute to the development of dysfunctional behavior when the evoking situation does not provide outlets for adequate coping responses or, alternatively, a viable means of escape from the source of stimulation when other means of adaptation are not possible.

A common source of such excessive emotional stimulation in dogs is separation distress. Separation-distressed dogs are highly motivated to reestablish social contact denied to them by isolation or confinement. Under such conditions, dogs may engage in various distressed behaviors like barking and howling, destructiveness, and loss of eliminatory control. Some dogs simply fall into a state of depression. The evoking emotions and situation conform to Scott's conditions of maladaptive behavior: a high degree of emotional arousal, absence of adequate coping alternatives, and no means of escape. The degree of separation reactivity exhibited by a dog is influenced by both genetic variations (some breeds appear more reactive to separation) and experience, with both factors contributing to the determining threshold and magnitude of separation distress.

Although many genetic and other biological factors play a significant part in the expression of emotional traits, the majority of behavior problems presented for training are acquired as the result of adverse learning experiences and, therefore, can be more or less remedied through behavior therapy and training. While the behavioral traits exhibited by the various dog breeds differ considerably in detail, the broad preparedness for learning is very similar among dogs regardless of their breed affiliation. Consequently, the dog's genetic and biological endowment is often treated as a virtual constant. One result of such biological similarity is the ease with which the various breeds undergo formal obedience training in a group setting without much in the way of special consideration for breed-specific needs. The most significant variable in analyzing and modifying adjustment problems is the learned component; however, inherited emotional factors cannot be ignored, especially in cases involving severe emotional disorders and aggression. Statistical evidence suggests that some breeds are more prone to develop behavior problems than others (Landsberg, 1991). These breed variations with respect to the incidence of behavior problems may be the result of selective breeding for potentially problematic traits (e.g., increased aggression or activity levels). In other cases, abnormal tendencies may have been inadvertently transmitted without intentional selective pressure (e.g., shyness and various common dysfunctional behavior patterns like fear biting and low-threshold dominance aggression).

Breed Variations

Among the various dog breeds, great variability can be seen regarding the ease with which they learn different tasks. The Border collie possesses a superb propensity for herding sheep—an ability not available to nonherding breeds. No amount of training will turn a black-and-tan coonhound into an able sheepherding dog, nor a Border collie into a steady trailing hound. Willis (1989) noted that the Border collie's ability to herd sheep not only depends on a genetic endowment (e.g., traits like crouching and *showing eye*) and intensive training but also on the selective breeding of sheep willing to be herded. Some breeds of sheep (notably African and Latin American

varieties) do not respond by grouping tightly together and fleeing when challenged by a Border collie but instead may attack the dog when provoked.

Even highly specific behavioral traits involve an apparent heredity factor. For example, Dalmatians were often kept as coach dogs in the past. These dogs were expected to run under the carriage and to maintain an ideal position just behind the horses. Keeler and Trimble (1940) found that the dog's position preference (trailing behind the carriage, lingering to the rear of the carriage, or running under the front axle) was to some extent determined by heredity. They bred several dogs together ranked in terms of their respective position preferences. At 6 months of age, the resulting puppies were yoked to an experienced coach dog to train them to perform the activity. After a brief period of training, the pups were released from the control of the experienced dog and observed. It was found that the trainees exhibited position preferences consistent with their parents' preferences. Although not conclusive, it appears that coach position is to some extent an inherited trait.

Clearly, genetic factors predispose dogs to exhibit certain inevitable behavioral strengths or weaknesses (Mackenzie et al., 1986). Sometimes these genetically wired behavioral predispositions are antagonistic with specific training goals, requiring extra effort to overcome or incorporate. Most of what a dog does can be interpreted in terms of innate behavioral predispositions manifested under the actualizing influence of learning. The important issue at stake here is not whether a dog exhibits innately prepared or instinctive behavior, but that such behavior exhibits sufficient variability and flexibility to be modified through training. Dogs are extremely adaptable animals both in terms of their range of biological diversification and their modes of behavioral expression. One need only bring to mind the delicate Italian greyhound standing in the shadow of a monumental Neapolitan mastiff in order to appreciate the incredible genetic variability of dogs. The morphological contrast between the two breeds is so striking that it is understandably hard for some people to believe that they derive their appearances and behavior from the same ancestral gene pool.

Hall (1941) referred to the animal's temperament endowment as the "raw stuff of individuality." This is especially true in the case of tendencies in the opposing directions of inhibition-introversion or excitability-extroversion. Some dogs are innately more inhibited and introverted, whereas others are more excitable and extroverted. Inherited temperament traits influence the way dogs learn and how they are most effectively trained. Measuring or objectively representing this "raw stuff" in dogs has prompted factor analyses (Royce, 1955; Cattell and Korth, 1973; Draper, 1995; Goodloe and Borchelt, 1998), efforts to quantify and describe breed attributes (Scott and Fuller, 1965; Hart and Hart, 1985), and predictive temperament tests (Pfaffenberger, 1963; Campbell, 1972; Vollmer, 1977, 1978). Various behavioral profiles have been devised to help potential dog owners to make rational decisions about their chosen breed's compatibility with their lifestyle and expectations of dog companionship (Tortora, 1980; Hart and Hart, 1988). The Waltham Centre for Pet Nutrition has organized a counseling service called Selectadog for assisting dog owners in search of the ideal canine companion. The service counsels around 4500 inquirers a year (Edney, 1987). All of these scientific and applied activities are based on the assumption that a considerable portion of a dog's behavior is affected by inherited tendencies and traits.

Temperament Testing

Various tests have been devised to assess the temperament of puppies, presumably to assist in the placement of puppies into appropriate homes. However, some skepticism about the reliability of early temperament testing has accumulated over the years, especially with regard to predicting dominance tendencies and dominance aggression—a behavior problem believed to depend on social learning and maturation, as well as genetic predisposition. Margaret Young (reported in Fogle, 1990) has questioned the effectiveness of early aptitude and temperament testing for predicting specific traits in adult dogs. She

found that many dogs that later proved to be difficult or aggressive were not detected by her battery of tests performed between 6 and 8 weeks of age:

> Social attraction, following and acceptance of stroking, did not reliably distinguish puppies that were later aloof and independent from those that were attracted toward people, readily trainable and handleable. Nor did tendencies identified by the test at seven weeks as dominant or submissive reliably predict later tendencies toward dominance or submissiveness. (1990:94)

However, she found that all puppies that displayed overt aggressive behavior (growling and barking) during testing were most likely to exhibit aggressive tendencies as adults. A study performed by Beaudet and colleagues (1994) questioned the reliability of puppy temperament testing for the detection of a predictive dominance factor in the temperament of young dogs. The researchers evaluated 39 puppies at 7 weeks of age according to the procedures recommended by Campbell (1972) and then once again at 16 weeks of age. The results were surprisingly negative. The study indicates that temperament-test results of 7-week-old puppies were not predictive of relative dominance exhibited by the same puppies when they were retested again at 16 weeks of age. According to the authors, "the test has no predictive value regarding future social tendencies. In fact, the total value of the behavioral scores for social tendencies between the two age groups showed a trend toward regression from dominance to submission" (Beaudet et al., 1994:273). These findings are consistent with the fluctuating dominance values found between these age groups by Scott and Fuller (1965). They early on discovered that relative dominance is a rather fluid social process that becomes progressively more stable and permanent as puppies mature.

Wright (1980) has also noted a great deal of individual variation with respect to competitive behavior and social dominance in puppies at the ages of 5.5, 8.5, and 11.5 weeks. One factor that was consistently correlated with competitive success was a willingness to explore a strange-complex situation actively: "Those puppies that were the least neophobic were also the ones that were able to control a desirable object in a competitive situation" (1980:23). Mahut (1958) also reported a significant correlation between a dog's willingness to explore novel and fear-eliciting objects and its relative fearlessness and aggressivity. Of the 10 breeds she studied, the ones most willing to explore and "tease" the fear-eliciting objects presented to them were also the ones known as "fighters, killers, and ratters." Pawlowski and Scott (1956) found clear evidence of hereditary influence on the expression of relative competitive dominance among various breeds of dogs (basenji, beagle, cocker spaniel, and wire-haired fox terrier), speculating that the more dominant breeds (basenji and terrier) possess a lower threshold for external stimulation and the arousal of fighting behavior. Another study supporting the general supposition that relative dominance is inherited was performed by James (1951), who cross-fostered two mixed litters of terrier and beagle pups, so that the litters were comprised of half beagles and half terriers. He observed that the social organization that developed between the puppies was a linear dominance hierarchy with terriers on top. Beagles and terriers tended to congregate in separate groups. Evidence of territorial expansion based on dominance was also found in the study. Terriers not only took the food presented, they also tended to defend the area against the trespass of beagles.

Among other predictive trait correlations that have been found between puppy and adult behavior, especially significant are early measures of general activity and excitability. Martinek and Hartl (1975), for example, reported a stable correlation between excitability and habituation rates in dogs at 4 months of age and their subsequent performance as guard dogs at 14 months. These early measures of excitability/habituation were highly predictive of an adult dog's trainability. Dogs situated on either extreme of the excitability continuum performed poorly during training as adult dogs. Those dogs exhibiting moderate excitability levels as puppies proved to be most trainable as adult guard dogs. Humphrey and Warner (1934) also found a

positive correlation between high energy (excitability) and adult aggressiveness. Additional support for this general hypothesis comes from studies by Goddard and Beilharz (1986), who determined that low activity levels in 12-week-old puppies were positively correlated with fearfulness in adult dogs. From 8 weeks onward, consistent individual differences in the expression of fear were observed—an observation consistent with findings reported previously by Fox (1966). The retrieving test was particularly reliable with regard to predicting *confidence* in adult dogs—fearful or emotionally inhibited puppies refused to fetch a ball.

Jackson Laboratory Studies

Scott and Fuller (1965) performed numerous experiments in an effort to quantify the relative contribution of heredity versus environment on the ontogenesis of the dog's behavior. They studied several generations of five breeds of dogs (basenji, beagle, cocker spaniel, wirehaired fox terrier, and Shetland sheepdog) and various crosses between them. The dogs were reared under similar conditions and then tested to compare and evaluate the inheritance of breed differences, including relative emotional reactivity, trainability, and problem-solving behavior. Clear differences were observed between the breeds studied. For example, wirehaired terriers, basenjis, and beagles were found to be much more emotionally reactive than cocker spaniels and Shetland sheepdogs, with the cocker spaniel being rated the most emotionally stable of the breeds studied. In terms of trainability, cocker spaniels also proved to be more responsive (both while being weighed and during leash training) than the other breeds tested. Somewhat surprisingly, the shelties were rated below the other breeds in terms of leash training, receiving most of their demerits as the result of jumping up or winding the leash around the handler's legs. The basenjis received high scores in terms of fighting the leash, whereas beagles exhibited the most reactive vocalizations during training. Cockers also performed better during an obedience test in which the dogs were trained to stay on a table for 30 seconds and then to jump off on command. Again, the basenjis proved the least cooperative of the five breeds. In terms of problem-solving behavior, the hunting breeds (basenjis, beagles, cockers, and terriers) outperformed the shelties. Scott and Fuller speculated that selective breeding may have had a direct bearing on these differences:

> This is probably because most of the tests were deliberately designed to test independent capacities motivated by food rewards; and it is noteworthy that the beagle, which is normally used for hunting without direction, shows the best over-all performance in terms of number of first ranks. By contrast, the Shetland sheep dogs, whose ancestors have been selected for their ability to perform complex tasks under close direction from their human masters, performed badly. Indeed, in many of the tests, the shelties gave the subjective impression of waiting around for someone to tell them what to do. Furthermore, while all the hunting breeds are strongly motivated by food, sheep dogs in general have been selected away from this trait. (1965:257)

An important factor influencing the outcome of many of the trainability and problem-solving tests was a dog's relative emotionality and degree of confidence or fear.

INHERITANCE OF FEAR

Krushinskii

Many studies have shown that emotional extremes involving fearfulness are inherited. Thorne (1944), for example, found that a "fear biting" basset hound named Paula had a tremendous genetic influence on a large group of her descendants in terms of their relative fearfulness. Of 59 dogs related to this highly reproductive female, 43 (73%) were shy and unfriendly. Thorne concluded that shyness was the result of a dominant trait and, therefore, not responsive to modification through learning and training. Krushinskii (1960) took exception to Thorne's conclusion that the shyness trait was unalterable through the influence of learning. He tracked the inheritance and expression of active defensive reactions (ADRs) and passive defensive reac-

tions (PDRs) in dogs. In the case of PDRs, if both parents exhibited the trait, the majority of the offspring would also show fearful tendencies. However, the expression of PDRs is highly dependent on environmental factors, especially socialization effects and environmental exposure. In opposition to Thorne, Krushinskii argued that the expression of shyness depended on both genotype and training conditions. The absence of active socialization together with environmental isolation tends to augment PDRs (shyness), whereas active socialization and the provision of environmental exposure tends to increase the exhibition of ADRs (aggressiveness). Krushinskii concluded that, although heredity plays a vital role in the expression of PDRs and ADRs, various environmental factors are also important in determining the final character of a dog's temperament.

Although experiential factors play an actualizing role in the expression of temperament excesses and deficits, breed differences clearly do exist. Thus, some breeds (and individuals) are more predisposed to become shy, while others are more prone to become aggressive. To quantify and compare these breed differences, Krushinskii studied the PDRs of German shepherds, Airedale terriers, and Doberman pinschers under conditions of home rearing and kennel isolation. He determined that decisive genetic differences exist between these different breeds, predisposing each to develop distinctive and varying degrees of passive defensive behavior. For example, the German shepherds were more prone to exhibit fearful behavior, regardless of the conditions of rearing. Further, while both German shepherds and Airedale terriers exhibited increased levels of passive defensive behavior following exposure to conditions of isolation, the shepherds exhibited more fearfulness than the terriers exposed to the same amount of isolation. Interestingly, Doberman pinschers were much less prone to exhibit increased PDRs as the result of isolation. Even when reared under extreme conditions of isolation, the expression of fearfulness in the Doberman pinschers studied was approximately the same as that exhibited by German shepherds that had been raised in a home environment.

Nervous Pointers

Murphree (1973) and his associates at the VA Hospital in Little Rock, Arkansas, found that a dog's tendency to develop fearful behavior toward humans is inherited. They have been systematically breeding a normal strain and a nervous strain of pointers for many years. The normal pointers, or A-dogs, are described as being active, socially outgoing, and very compliant to experimental tasks. They are able learners and resistant to the induction of experimental neurosis. The nervous pointers, or E-dogs, are prone to fearful extremes in behavior, exhibiting an intense aversion toward human contact. In the presence of humans, the E-dogs retreat and become tense (catatonic rigidity) and wide-eyed; in general, a stark contrast to the normal pointers. E-dogs are further distinguished by being smaller and more prone to develop severe mange, a condition that may be related to stress-induced immunosuppression.

Several physiological differences have been observed between normal and nervous pointers. The HPA system is directly affected by chronic fear and stress. However, as noted in Chapter 3, Klein and coworkers (1990) were unable to demonstrate significant differences between normal and nervous dogs with regard to HPA system activity (e.g., increased ACTH and cortisol levels). This finding conflicts with an earlier study performed by Pasley and colleagues (1978) that found that E-dogs had larger adrenal glands than A-dogs. Klein and colleagues attributed this apparent conflict of findings to the influence of episodic stress taking place only in the presence of humans and, therefore, not detectable by their baseline measurements. It should be noted in this regard, that E-dogs appear normal and relaxed while interacting with other pointers; it is only when they come in contact with humans that they show signs of fear. Uhde and coworkers (1992) found clear differences in the body weights of normal versus nervous dogs, with the most fearful patterns of behavior being exhibited by female dogs weighing the least. Additionally, they found that an inverse relationship ex-

isted between a dog's degree of fearfulness, her body weight, and plasma levels of insulin-like growth factor I (IGF-I). Fearful dogs exhibited significantly lower levels of IGF-I, suggesting that chronic fear may adversely affect the hypothalamic-growth hormone axis. With respect to brain substrate differences, Lucas and colleagues (1974) found distinct differences in hippocampal theta-wave activity between normal dogs and nervous dogs. Spontaneous hippocampal theta-wave activity is associated with arousal occurring in the presence of familiar stimuli or following habituation to novelty. On the other hand, desynchronization of theta-wave activity is evoked during the elicitation of the orienting response, during escape from aversive stimulation, and following intracranial stimulation of the reticular formation. A decrease in theta-wave activity indicates momentary neural inhibition and increased vigilance, whereas increased rhythmic theta-wave activity is associated with a relaxed, alert state. Nervous pointers exhibit less hippocampal theta-wave activity than normal counterparts. This evidence seems to implicate the hippocampus as important neural substrate mediating lower fear thresholds and prolonged states of generalized anxious arousal in such dogs:

> These data indicated to us that nervous pointer dogs do not exhibit a normal response in their hippocampogram to environmental stimuli. We believe that these animals remain in the initial phase of the orienting response (desynchronization of the hippocampogram) and that habituation fails to occur. (Lucas et al., 1974:612)

Lastly, while in the presence of humans, the heart-rate patterns of normal and nervous dogs differ significantly (Newton and Lucas, 1982). Nervous dogs exhibit reduced heart rates both when a person is in the room (without petting) and also when petted. In contrast, normal dogs exhibit an *increase* in heart rates only when a person enters the room, but a slower rate (returning to baseline) while being petted.

A striking sensory difference between nervous and normal pointers is the existence of a much higher incidence of deafness in nervous dogs. Klein and colleagues (1988) found that most of the nervous dogs that they tested were deaf. Despite this finding, the researchers emphasize that nervous behavior occurs independently of a dog's hearing ability, with hearing and deaf nervous dogs exhibiting similarly abnormal behavior. In another study, involving a colony of pointers studied at the National Institute of Mental Health (Bethesda, MD), 21 of 28 nervous dogs were found to be deaf. In contrast, among the 16 normal pointers tested, 15 had normal hearing, with one exhibiting loss of hearing in one ear (Steinberg et al., 1994).

Although nervous dogs are more prone to exhibit fearful behavior toward humans than are normal pointers, the former do respond variably (with some benefit) to rehabilitative efforts, including supplemental socialization and graduated desensitization. For example, Reese (1978) reported an experiment in which a litter of six nervous-strain puppies were divided so that three of them were home reared while the other three were raised under ordinary laboratory conditions. The home-reared and laboratory-reared puppies were then tested and compared. The results indicated that the home-reared puppies exhibited some improvement in terms of social responsiveness to humans that was not evident in lab-reared siblings. However, the benefit of home rearing was short-lived. By 12 months of age, little difference between the two groups was observed in terms of their response to human contact. In another rehabilitative experiment, an effort was made to train nervous pointers to hunt (McBryde and Murphree, 1974). Surprisingly, the researchers discovered that after patient training, involving gradual desensitization and social facilitation, the pointers not only became successful hunters (practically indistinguishable from normal pointers), they also learned to tolerate close working contact with humans while in the field. This apparent benefit did not, however, generalize back to the laboratory setting—test scores within that context remained essentially constant.

Murphree and Newton (1971) found that avoidance responding could be attenuated somewhat by providing lab-reared puppies with intensive supplemental socialization and

exposure to positive human contact. This additional socialization included daily 30-minute sessions of affectionate holding and play. While nervous puppies showed limited benefit from such additional social contact, normal puppies exhibited a much more pronounced benefit as a result of such treatment. Experiments like the foregoing led Reese (1978) to speculate that the basic difference between nervous E-dogs and normal A-dogs was their variable responsiveness with respect to negative and positive reinforcement. He contended that E-dogs were more sensitive to negative reinforcement, whereas normal A-dogs were more sensitive to the effects of positive reinforcement. The outcome of this selective sensitivity was that nervous dogs were more negatively influenced by the aversive effects of routine handling and testing. On the other hand, A-dogs responded more readily to the positive events occurring during the same routine handling, thus accounting for their increased benefit from supplemental socialization efforts. Reese concluded, "The fact that a high percentage of A's remain friendly and cooperative seems just as remarkable as the fact that a high percentage of E's do not" (1978:172).

Heredity and Intelligence

Intelligence is a complex and largely indeterminate aspect of a dog's cognitive endowment. Serious attempts to quantify it as an independent factor have been frustrated by both conceptual and experimental inadequacies. Even finding agreement on what is signified by the word *intelligence* is not easily obtained from one authority to the next. Intelligence is embedded in a web of interactive factors, including sensory abilities, motor skills, emotional reactivity, general motivation, and previous learning experiences. To my knowledge, no controlled experiments with dogs have been performed to measure intelligence while at the same time properly excluding the influence of these extraneous factors. The results of most animal intelligence studies to date are confounded by experimental shortcomings that measure more than intelligence per se. Instead of measuring intellectual ability, IQ tests measure a cluster of factors among which intelligence may or may not play a prominent role.

Measuring Intelligence

To rectify this problem, a reasonable starting point for the study of dog intelligence might begin with the design of an adequate series of controlled experiments. One *hypothetical* possibility is to compare multiple subjects in terms of their differential rate of learning and problem solving in a situation where all other variables are controlled for except *rate of learning* or *insight*. The next step would be to isolate and group these animals into slow and fast learners. To ensure that this apparent difference is of an innate origin, genetic studies would have to be undertaken to breed selectively for slower and faster learners from the segregated groups. By genetically augmenting their respective strengths and weaknesses, two strains of efficient and deficient learners would theoretically be produced. Additionally, the hypothetical study could be extended to include a comparison of genetically slow and fast learners with regard to their acquisition of other diverse skills, thereby determining the extent to which the proposed intelligence factor generalizes to other problem-solving situations. However, even if such careful studies were actually carried out, they would probably prove to be a waste of time and effort.

In fact, many behavioral studies like the above have been performed on rats. Early on, Tolman (1924) and Tryon (1929, 1934) found that maze-learning ability in rats was inherited. Both researchers selectively bred maze-dull and maze-bright rats, thereby developing two distinct strains of rats based on maze-learning ability. Speculation that such enhanced learning ability resulted from a general intelligence factor was not supported by subsequent experimentation, however. The deciding factor in maze learning was not intelligence but rather differences of emotional reactivity exhibited by the two strains. Searle (1949) tested the two strains of rats under various maze conditions and concluded that maze-dull rats were simply more fearful and timid of the maze situation—not less intelligent. Further, additional studies involving

maze-bright and maze-dull rats demonstrated that maze-bright rats are not necessarily better learners than maze-dull rats when tested on tasks other than maze learning (Wahlsten, 1972). Intelligence appears to be an epiphenomenon compounded of many underlying predisposing factors and experiential contributions, including emotional reactivity, locomotor ability, sensory acuity, and sensitivity to hedonically significant outcomes (positive and negative training events).

E. G. Sarris (University of Hamburg) performed a series of experiments and observations to assess intelligent behavior in dogs, especially in terms of trial-and-error learning and "insight." He posed a number of problems for a variety of dogs at various ages, involving varying degrees of difficulty. Besides evaluating maze performance, he recorded learning styles and strategies used by dogs to solve problems requiring the physical manipulation of ropes, boxes, doors, stairs, and wagons as aids. What makes Sarris's study so intriguing and valuable is the care he took to describe the behavior he patiently observed. The report, published as a four-part series in the *American Kennel Gazette* (Sarris, 1938–1939), contains a diary of notes and photographs illustrating his findings. Sarris emphasized the need for appreciating the dog's special "umwelt" or subjective schema with which it organizes its experience of the environment. He argued that temperament and intelligence are mutually interdependent influences that inform a dog's umwelt and problem-solving behavior. Problems are conceived of as unaccustomed umwelt conditions that require a dog to vary customary patterns of behavior in novel ways to arrive at a solution: "Everything originating in the human 'Umvelt' has to be transformed in to 'dog things,' in order that the brain of the dog can grasp and co-ordinate it" (Feb 1939:24). In this regard, a dog's ability to play provides a decisive factor. Sarris notes that play is an "infallible" individualizing indicator of a dog's temperament and relative intelligence. Play appears to mediate intelligent adaptations by allowing a dog to discover and to explore options fearlessly outside of the usual pattern. The quality of a dog's intelligence and temperament are expressed through its ability to play. Although Sarris accomplishes his goal of demonstrating the existence of individual differences in dogs, more importantly his patient observations captured unique glimpses into the range and potential sagacity of canine intelligence that are often overlooked under less natural conditions of study.

Measuring Differences in Intelligence

Clearly, the measurement of dog intelligence and its relative distribution among dog breeds will not be advanced by pop psychology, simplistic IQ tests, and contrived intelligence rankings à la Coren (1994). Scott and Fuller, after reviewing the results of 13 years of highly controlled testing and evaluation of dog problem solving and learning ability in various breeds, concluded with respect to dog intelligence that all dogs exhibit a similar profile when other factors like emotional reactivity and motivation are held constant or factored out:

> On the basis of the information we now have, we can conclude that all breeds show about the same average level of performance in problem solving, provided they can be adequately motivated, provided physical differences and handicaps do not affect the tests, and provided interfering emotional reactions such as fear can be eliminated. In short, all the breeds appear quite similar in pure intelligence. (1965:258)

Scott and Fuller concluded that all dogs do about equally well so long as they can be comparably motivated and relaxed during training and testing. Further, they note that a dog's relative ability to solve problems and to learn is not due to a genetically transmitted intelligence factor per se, but, more significantly, such ability depends on the presence of emotional attributes that are compatible with the tasks required.

There is a tendency among dog owners to equate intelligence with trainability. But does a dog's trainability and obedience depend on its intelligence? The available scientific evidence indicates that a willingness to accept training and to perform obediently are not necessarily correlated with intelligence. Fox succinctly denies a relationship between intel-

ligence and obedience: "Obedience, however, like trainability, is not a sign of intelligence, and obedience training to stay, sit, retrieve, and so on are not measures of intelligence per se" (1972:112).

Many ethologists studying wild canids have expressed the belief that wolves are more intelligent than domestic dogs, yet even hand-reared wolves are very difficult to train and often refuse to perform the most rudimentary obedience tasks; they are simply not prepared to learn such things—at least under conventional methods of training. Dogs, on the other hand, readily learn to exchange obedience for reassuring affection and are easily subordinated by threats and compulsion. When wolves are exposed to formal obedience training, they may attempt to flee and, if escape is blocked, may struggle or attack. The wolf's responses to forceful handling are biologically programmed species-typical defensive reactions. While an intelligence factor is undoubtedly present, the average dog's trainability is more influenced by the way the dog reacts to rewards or emotionally provocative coercion. Although intelligence may be an important factor in training, other traits and predispositions prepare some dogs to learn more efficiently—for example, a high degree of emotional dependency, ease of subordination to handler control, and low reactivity to physical aversive stimulation. These traits and others conducive to obedience training are selected for, especially in the herding and retriever-type dogs.

There can be little doubt that some dog breeds accept obedience training better than others. However, this does not necessarily imply that breeds performing well in obedience competition are more or less intelligent than counterparts not performing as well in the ring. Preparedness to learn a task is often confused with intelligence, and contrapreparedness to learn is considered something akin to stupidity. Dogs are specialists, so it is extremely misleading to compare the rate that different breeds learn an arbitrary skill (like obedience) for which they are not equally prepared through selective breeding to learn. The intelligence of dogs is remarkably similar from breed to breed. In fact, as Scott and Fuller (1965) have noted, the greatest differences in intelligence exist between individuals belonging to the same breed rather than between the various breeds. However, many of these intrabreed differences (where they exist) are probably more the result of early training and rearing practices than the workings of an innate intelligence factor.

The dog's versatility as a domestic species is reflected in the ease with which it is trained and adapted to so many varied roles and environments. As the result of many thousands of years of conscious and unconscious selective breeding, dogs have accrued many adaptive behavioral changes, including an aptitude for training and a desire for close social contact with humans. While a dog's behavior is informed by an ancient phylogenetic heritage, its success as "man's best friend" is not governed by genes alone but by the dog's ability to learn. As will be repeatedly emphasized throughout the remainder of this book, our dogs' ability to learn from the consequences of their actions, and thereby to adjust their behavior to fit more precisely the demands of the surrounding environment, is central to the dog's success as humankind's closest animal ally and companion.

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6

Classical Conditioning

It is pretty evident that under natural conditions the normal animal must respond not only to stimuli which themselves bring immediate benefit or harm, but also to other physical or chemical agencies—waves of sound, light, and the like—which in themselves only signal the approach of these stimuli; though it is not the sight and sound of the beast of prey which is in itself harmful to the smaller animal, but its teeth and claws.

I. P. PAVLOV, *Conditioned Reflexes* (1927/1960)

THE CHANGING circumstances of the environment pose many behavioral and biological challenges for animals. The body is organized to accommodate many of these changes through physiological mechanisms that are directly or indirectly influenced by the action of reflexes. These reflexive actions facilitate a variety of behavioral adaptations and help to maintain biological homeostasis in the face of internal and external environmental change. The adaptive functioning of these various reflexive mechanisms depends on an active emotional, behavioral, and sensory interface between the animal and its environment. Just as the stimuli eliciting these reflexes are mostly outside of the animal's control, the responses involved are largely involuntary and occur irrespective of the animal's efforts.

Reflexes are comprised of unconditioned responses that are elicited by unconditioned stimuli having evolutionary significance for the animal and the ecological niche within which it is adapted to live. In addition, neutral stimuli that possess no such evocative capacity of their own may gradually become conditioned stimuli with the ability to elicit such reflex actions. This is accomplished by the neutral stimulus occurring regularly in close contiguity and proximity with the evocation of some unconditioned reflex. As a result, the previously neutral stimulus becomes a conditioned stimulus, with the power to elicit the target reflexive adjustment, originally only elicited by the unconditioned stimulus. This general arrangement of conditioned and unconditioned stimuli provides the raw data of classical conditioning. Associative processes translate such stimulus-response relations into predictive representations and encode them for future use. The result of this associative learning ability is enhanced behavioral flexibility, providing the animal with many advantages in terms of anticipating the occurrence or nonoccurrence of appetitive (attractive) and aversive events, such as the avoidance of danger. The appetitive usefulness of such learning is particularly significant in the case of predators, who rely on signs and traces left by the prey animal in order to track and secure a meal. The prey animal, on the other hand, is able to learn signals that regularly occur in advance of predatory attacks and, thereby, has a better chance of evading capture by the predator. In general, such acquired information about the environment optimizes an animal's access to essential resources and the maintenance of safety.

PAVLOV'S DISCOVERY

Ivan P. Pavlov (1927/1960) is credited with the discovery of *classical* or, in the terminology of behavior analysis, *respondent conditioning*. According to Pavlov, sensory inputs stimulate the nervous system in one of two opposing directions: excitation or inhibition. Normal nervous activity is the result of a harmonious interplay of excitatory and inhibitory processes mediated by afferent sensory inputs that are collected, organized, and interpreted by central neural mechanisms. Pavlov viewed the physiological significance of reflexive behavior in terms of *psychic* balance: "Reflexes are the elemental units in the mechanism of perpetual equilibration" (1927/1960:8). Classical conditioning is the most fundamental manner in which the animal learns about the changing stimulus contingencies in the surrounding environment, adjusting to them through the anticipatory action of various preservative and protective mechanisms. Through classical conditioning, innate reflexes are brought under the predictive control of causally independent (i.e., neutral) stimuli that are related to the unconditioned stimulus-response event by temporal contiguity and spatial orientation. Such learning is normally outside of voluntary control and is largely (but not entirely) independent of response-generated consequences (e.g., rewards and punishment).

Classical conditioning appears to have been discovered by chance. Pavlov, a physiologist, was occupied with an investigation of the dog's salivary response when he noticed that the more experienced dogs that he had been testing began to salivate before the samples of food were presented to them. This anticipation seriously confounded his physiological measurements of salivary flow in the presence of food but led him to make a much more important psychological discovery. He

concluded that the alterations in salivary flow that he observed in his dogs were mediated by higher cortical mechanisms. Further, he hypothesized that the dog's salivary response could be used as an objective measure with which to investigate these higher nervous functions systematically "without any need to resort to fantastic speculations as to the existence of any possible subjective state in the animal which may be conjectured on analogy with ourselves" (1927/1960:16). By varying the stimulus event along several dimensions (e.g., intensity, duration, frequency, and contiguity) and carefully measuring and recording the amount of the dog's salivation, he believed that solid inferences could be drawn about associated brain activity and hypotheses tested with regard to the causal mechanisms at work.

The salivary response turned out to be an *overly* sensitive barometer of stimulus activity. The dog was not only affected by the test stimulus but also by many extraneous stimuli, like the presence of the experimenter or various ambient disturbances. Consequently, Pavlov had a special laboratory constructed in which the experimenter and dog were separated from each other in soundproofed rooms. Prior to testing, the dog's salivary ducts were surgically severed and passed through the cheek and attached to a fistula that conducted salivary secretions into a measuring device. Throughout the experiment, the dog was restrained in a harness attached to a sturdy frame that prevented it from moving about. While restrained in the harness, the dog was exposed to a wide variety of arbitrary stimuli (e.g., bell, light, metronome, and even electric current) presented contiguously with food powder.

Basic Conditioning Arrangements Between Conditioned Stimulus and Unconditioned Stimulus

All reflexes are composed of an *unconditioned stimulus* (US) and an *unconditioned response* (UR). Under ordinary circumstances, the US invariably elicits the UR. For example, Pavlov found that hungry dogs will almost always salivate when presented with food. Most other stimuli falling on a dog's senses fail to elicit this stimulus-specific response—that is, they are neutral with regard to salivation. However, if one of these neutral stimuli (e.g., a tone) is repeatedly paired in close contiguity with the US (food), the previously irrelevant and *neutral stimulus* (NS) will begin to elicit the associated UR (salivation) independently of the reinforcing US. Conditioning transforms the originally neutral stimulus into a *conditioned stimulus* (CS) capable of eliciting a *conditioned response* (CR). Taken as a unit, the CS and CR are referred to as a *conditioned reflex*. The associative bond between the CS and the US is strengthened when the CS consistently occurs just before the presentation of the US and is weakened (extinction) when the CS and US occur independently of each other (Fig. 6.1).

Classical conditioning connects stimulus events together in an orderly way. An important function of associative learning is to provide dogs with predictive information about the occurrence or nonoccurrence of significant events. This information is derived from the regular concurrence or lack of concurrence between the CS complex (stimulus and context) and the occurrence of the US. Pavlov found that classical conditioning is strongly influenced by the temporal proximity and order of the conditioning stimuli involved (Fig. 6.2). Classical learning dictates that the CS closely precede the US in order for conditioning to occur. The optimal temporal relationship between the CS and US for practical purposes is obtained by presenting the CS approximately one-half second before the onset of the US. If the CS is presented after the US (*backward conditioning*) or separated by too much time from the US (*trace conditioning*), the associative bond between the CS and US will be weak or conditioning may not take place at all. An important exception to this general rule is found in a special conditioning phenomenon known as taste aversion, which is discussed in detail later in this chapter.

If the CS regularly occurs shortly before the US (*short-delay conditioning*), it gradually becomes predictive for the occurrence of the US. If the CS and US occur together (*simultaneous conditioning*), the arrangement is ana-

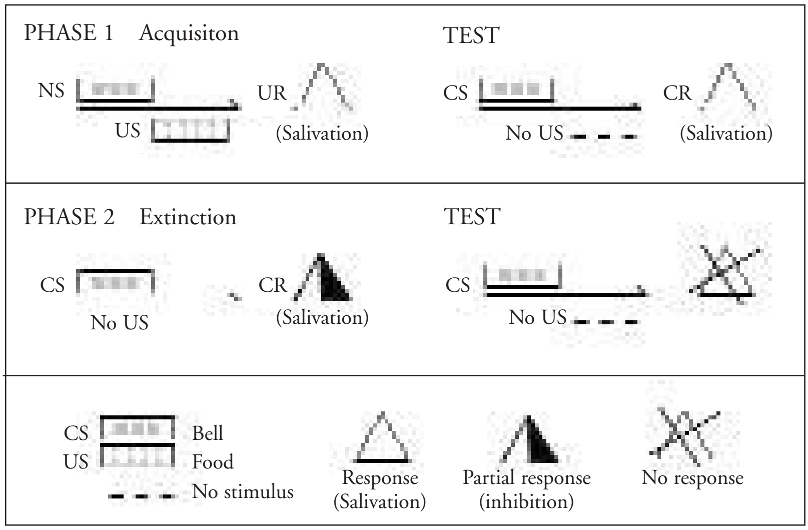

Fig. 6.1. Repeatedly following the connditioned stimulus (CS) with the unconditioned stimulus (US) results in acquisition of a conditioned response (CR), whereas, repeated presentation of the CS independently of the US results in extinction. NS, neutral stimulus; UR, unconditioned response.

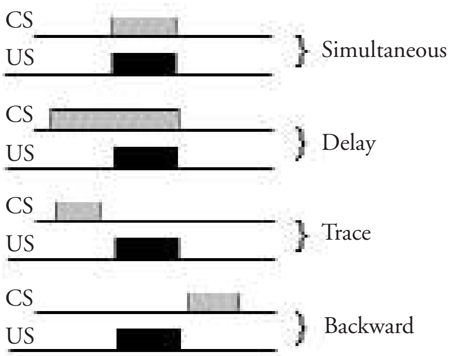

Fig. 6.2. Varieties of classical conditioning arrangement based on the temporal relation of the conditioned stimulus (CS) to the unconditioned stimulus (US). The least efficient forms of conditioning occur when the CS is presented simultaneously with the US or presented after it occurs.

lytical—the occurrence of the CS is temporally coextensive with the US. Finally, if the CS occurs after the US (*backward conditioning*) the cognitive correlate is inferential—that is, one can infer that the US has just occurred by the presence of the CS, but the CS fails to become predictive for the US. Although the latter two outcomes of classical conditioning may be of significance to human reasoning and causal thinking, such analytical and inferential cognitions play a much less important role in understanding associative processes in animal learning.

Common Examples of Classical Conditioning

A few everyday examples of classical conditioning will hopefully serve to illustrate how the process works. Most dogs respond readily to the sound of a doorbell ringing. For the first few times, however, the bell would probably produce little effect in a dog other than an orienting response and some curiosity. After several repetitions, though, in which the bell signals the arrival of someone at the door, the dog may begin to respond to the bell in anticipation of meeting the visitor at the door. In other words, the dog has learned to correlate a previously insignificant event with a significant one. Now when the doorbell rings, the dog dances with excitement anticipating the visitor's entry and greeting. However, if the owner decided that all this enthusiasm was a bit too much, he or she might endeavor to reduce it by repeatedly ringing the bell without opening the door.

After several daily sessions of nonreinforced exposures to the bell, the dog will gradually inhibit its anticipatory reactions and finally ignore the sound altogether. The ringing bell has been disconfirmed as a predictive cue and is now correlated with nothing special when it rings—that is, its conditioned effect has been *extinguished.* After a few of days without additional extinction trials, though, if an actual guest happens along and rings the doorbell, the owner may find that the dog's reaction had in the interim returned to nearly its original strength. This conditioning phenomenon is known as *spontaneous recovery.* More interestingly, though, is what occurs over the course of several hundred trials of differential reinforcement of the CS-US relationship. If the percentage of confirming rings (guest present) is exactly equal to the percentage of discomfirming rings (guest not present), the sum outcome is the neutralization of the doorbell as a predictive cue (the dog learns to ignore it). Stimulus neutrality results when the occurrence of the US is rendered independent of the occurrence or nonoccurrence of the CS—that is, the US is as likely to occur in the presence of the CS as it is in the absence of the CS (Rescorla, 1988). This formulation of classical conditioning has many implications for dog training and is discussed in greater detail below.

Classical conditioning mechanisms also play an important role in the development of fears and anxiety. A neutral stimulus is readily conditioned to elicit startle or fear by being paired with a fear-eliciting US. For instance, dogs frequently develop fears associated with the veterinary clinic, especially if they have undergone painful procedures there in the past. Such dogs may begin showing signs of anxiety as soon as they enter the hospital parking lot. Providing dogs or puppies with treats and other pleasurable experiences while being examined may help to prevent such negative associations, perhaps even leading the animals to look forward to the experience rather than fearing it. Lifelong phobic reactions can occur as the result of a single traumatic event. Dogs suffer a broad spectrum of phobic fears, most of which are established and reversed through classical conditioning procedures.

Many additional examples of classical conditioning could be cited, but a particularly useful one involves the conditioning of bridging stimuli or conditioned reinforcers. A *bridge stimulus* is a signal that connects the emission of a desired behavior with a delayed reinforcement. A bridge stimulus is also referred to as a *conditioned reinforcer*. During training, it is not always possible to reinforce a selected behavior directly at the exact moment when it is emitted. Still, it is very desirable that a dog be given positive feedback from the trainer at such times. The conditioned reinforcer takes the place of the unconditioned reinforcer (reward) until it can be given to the dog later. A common bridging cue used in dog training is the word signal "Good" or the sound made by depressing a tin clicker. By repeatedly pairing the word signal "Good" with food or other rewards, the previously neutral vocal sound or click is gradually transformed into a generalized reinforcer capable of strengthening selected actions, sequences, or patterns of behavior from a dog's instrumental repertoire. On the other hand, by carefully pairing aversive events or the absence of reinforcement with word signals like "No" or "Enough," then a *conditioned punisher* is produced. Experienced dogs quickly learn to avoid or abandon offending behaviors that trigger the onset of such conditioned punishers or reprimands. The foregoing discussion anticipates a more thorough treatment of conditioned reinforcement covered in the following chapter devoted to instrumental learning.

Konorski's Conceptualization of Reflexive Behavior

J. Konorski (1967) extended Pavlov's excitatory-inhibitory paradigm of classical conditioning to include an analysis of the ethologically significant central mechanisms and drives underpinning the process. According to Konorski, a dog's reflexive behavior can be divided into two general biological categories—preservative or protective—depending on the reflex's adaptive function (Fig. 6.3). The term *preservative* denotes the set of reflexive behavioral adjustments employed to satisfy basic needs like nutrition, warmth, so-

Preservative preparatory	Preservative consummatory
Protective preparatory	Protective consummatory

FIG. 6.3. Konorski's (1967) classification of adaptive behavior.

cial contact, and reproduction, whereas the term *protective* denotes the set of reflexive behavioral adjustments that either direct the animal away from noxious or dangerous stimuli (flight) or cause the animal to attempt to destroy them (fight). Preservative reflexes are appetitive and elicited by attractive stimuli, whereas protective reflexes are defensive and elicited by aversive stimuli. These reflexive mechanisms are related to one another along an approach-withdrawal continuum based on a biological optimization of the organism's well-being and adaptation to the surrounding environment.

Preparatory and Consummatory Reflexes

This scheme of reflexive organization is further subdivided into two sequential and interdependent modes of expression that Konorski refers to as preparation and consummation. Both preservative and protective reflexes are expressed through these two sequencing modes. The term *preparatory* denotes all the drive and emotional factors compelling a dog to seek out attractive stimuli or to avoid aversive ones. *Consummatory* reflexes include all those reflex actions associated with the adaptive demands made by the environment upon a dog. Preservative consummatory reflexes include biological actions like salivation, mastication, drinking, and swallowing. Protective consummatory reflexes are composed of both defensive and offensive reactions. Defensive reflexes include escape-avoidance responses and various biological rejection reflexes like vomiting, sneezing, spitting, shaking, scratching, and blinking. Offensive consummatory reflexes include various forms of aggressive behavior directed toward the control or destruction of a threatening or harmful target.

Preparatory reflexes are composed of centrally organized motivational and evocative mechanisms arousing an animal to action in the mutually exclusive directions of attraction or repulsion. Alimentary reflexes, whether involving eating, urinating, or defecating, depend on the operation of a number of internal preparatory reflexes that provide the necessary motivational conditions for the specific consummatory actions to occur. The preservative action of eating, for example, is composed of preparatory reflexes related to hunger, which set the motivational occasion for the consummatory reflexes associated with the ingestion of food. The amount of hunger experienced by an animal directly affects the magnitude of the consummatory eating reflex finally expressed. Likewise, elimination is comprised of an interaction of preparatory and consummatory reflexes. As the result of pressure-sensitive receptors located in the bladder and bowel, preparatory reflexes are elicited that set the motivational occasions for the consummatory actions of urinating or defecating.

A similar cooperative arrangement between preparation and consummation mediates the expression of protective reflexes. Preparatory protective reflexes involve the escape-avoidance of painful or fearful internal states. Fear is essentially an autonomic response preparing the organism with appropriate emotional arousal for the occurrence of aversive stimulation:

> There is no doubt that most fear reflexes are closely correlated with pain. As a matter of fact, every living creature is afraid of pain, and a large part of its behavior is concerned with developing such preparatory activities as would prevent the occurrence of painful stimuli. It is, however, clear that preventing a noxious stimulus depends upon its anticipation, which is usually accomplished through conditioning. (Konorski, 1967:30)

Some fears, however, do not appear to depend on a conditioning process to develop. Such fears are, in the terminology of Seligman (1971), biologically *prepared* (or *hardwired*). Many dogs are innately fearful of loud, startling noises like fireworks or thun-

der. Some are emotionally reactive toward separation or isolation in an unfamiliar place, leading to intense preparatory reactions aimed at restoring contact. Virtually all normal dogs exhibit varying degrees of fear toward painful stimulation. The fearful experiences of loud noises, isolation, or pain are innately programmed reactions or URs to sufficiently salient and evocative unconditioned stimuli.

During fearful stimulation, animals will choose a strategy of active or passive defense. When faced with intense fear, dogs are thrown into a three-way dilemma, requiring them to decide whether or not to flee, freeze, or fight. Opting to freeze, a common defense choice among small prey animals, is a passive defensive reflex. Running away, as well as fighting, are both conceptualized as active defensive reflexes. Defensive reflexes are emotionally and centrally opposed by a *relief subsystem* that serves to counteract fearful effects when the fear-eliciting stimulus is withdrawn.

Besides the preparatory reflexes associated with increasing fear, animals are prepared for defensive and offensive activity through the elicitation of preparatory anger reflexes. The physiological and behavioral effects of anger are very different from those associated with fear. Angry feelings express themselves through frontally oriented displays, including intense facial threat gestures, stiff-legged body posturing with front legs prominent, and an overall enhancement of body size (piloerection and muscular tensing) and carriage in the direction of the target. During fearful displays, the direction of action tends to move toward the rear, with submissive fawning or preparations to flee.

Targeting Reflex

Another important group of consummatory reflexes are the so-called *targeting reflexes* or those reflexes that "denote the adjustment of a given analyzer to the better perception of a stimulus" (Konorski, 1967:17). All sensory organs exhibit a variety of targeting reflexes that assist in the efficient and accurate organization of sensory perception. For example, the visual targeting reflex includes orientation of the head and eyes on the object of interest, the adjustment of the pupils and lenses, and converging of the eyes on a single item of focused attention. Similarly, audition is made possible through the operation of various auditory targeting reflexes, including turning the head toward the source of sound, pricking the ears, and various muscular actions occurring in the middle ear. Consummatory targeting reflexes are driven by preparatory arousal in the form of curiosity or a searching reflex.

Searching behavior is triggered and directed by motivationally significant needs and deprivation states (e.g., food, comfort, and sex), but many animals, including dogs, exhibit a general curiosity about the environment and a need for sensory stimulation in itself. Even under conditions where a dog is not driven to find a particular satisfaction, it may engage in general *undirected* or playful exploration of its surroundings. There may exist a physiological requirement for a certain amount of daily sensory and somatic stimulation that the animal needs in order to feel sufficiently content to abstain from exploratory activity. Sensory and social deprivation may result in the display of exaggerated compensatory reactions designed to satisfy an intensified need for stimulation and social attention.

Rescorla's Contingency Model of Classical Conditioning

Pavlov viewed conditioning from the perspective of a physiologist, leading him to form a mechanistic interpretation of the cognitive and emotional dynamics governing the process. Rescorla questioned Pavlov's contiguity theory of classical conditioning and posited an alternative account that emphasized the importance of *contingency*:

> The notion of contingency differs from that of pairing in that it includes not only what events are paired but also what events are not paired. As used here, contingency refers to the relative probability of occurrence of US in the presence of CS as contrasted with its probability in the absence of CS. The contingency notion suggests that, in fact, conditioning only occurs when these probabilities differ; when the prob-

> ability of US is higher during CS than at other times, excitatory condition occurs; when the probability is lower, inhibitory conditioning results. Notice that the probability of a US can be the same in the absence and presence of CS and yet there can be a fair number of CS-US pairings. It is this that makes it possible to assess the relative importance of pairing and contingency in the development of a CR. (1968:1)

Rescorla interprets conditioning from a cognitive viewpoint attributing both predictive and informative properties to the CS. The model places equal importance on the presence as well as the absence of the CS in relation to the occurrence of the US. According to Rescorla, associative conditioning depends on a predictive contingency (both positive and negative) holding between the CS and US. If the US occurs regardless of the presence or absence of the CS (i.e., the US occurs independently of the CS), then in spite of many *chance* pairings between the CS and US (all being offset by an equal number of US events occurring without the CS), no effective conditioning takes place. Under conditions in which the US occurs independently of the presence or absence of the CS, the CS is neutralized (Rescorla, 1967). Rescorla's important discovery suggests that classical conditioning is a contingency-based process in which the CS functions as a statistically informative signal about the probability of the occurrence or nonoccurrence of the US (Fig. 6.4).

As a supplement or correction to the contiguity theory, the contingency theory provides a coherent and elegant way to describe what takes place during classical conditioning. Besides predicting the occurrence of the US, the CS also provides information about the type and size (magnitude) of the anticipated UR, as well as various significant contextual relations between the occurrence of the CS and CR. But, as Rescorla writes, "It is not only temporal and logical relations among events that are important to conditioning. Conditioning is also sensitive to relations involving the properties of the events themselves" (1988:153).

Formulating predictions about such information requires that the CS be somehow associatively linked with the US eliciting the UR. The so-called stimulus-stimulus (S-S)

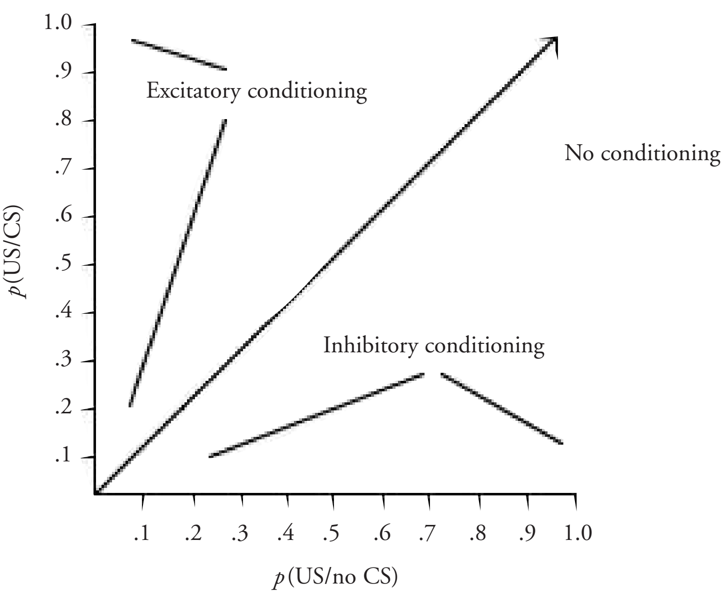

FIG. 6.4. Probability (*p*) space describing excitatory and inhibitory conditioning. CS, conditioned stimulus; US, unconditioned stimulus.

theory of classical conditioning asserts that the connection between CS and US events is mediated by control centers in the brain, perhaps corresponding to Gray's septal-hippocampal comparator system, "a system which, moment to moment predicts the next likely event and compares this prediction to the actual event" (Gray, 1991:112) (see Chapter 3).

Predictions about the size of the US are estimated along an excitatory-inhibitory dimension. If the CS underestimates the size of the pending US, excitatory learning takes place (*acquisition*). If the CS overestimates the size of the US, inhibitory learning occurs (*extinction*). If the CS accurately estimates the size of the US, no additional learning takes place (*steady state* or *homeostasis*). Classical conditioning is acquired, maintained, or extinguished on the basis of a variable correlation between a predictive CS and a corresponding US. Acquisition or extinction occurs when a dog's expectation of a pending event is different from what actually happens. Regarding this relationship, Rescorla and Wagner write,

> Organisms only learn when events violate their expectations. Certain expectations are built up about the events following a stimulus complex; expectations initiated by that complex and its component stimuli are then only modified when consequent events disagree with the composite expectation. (1972:75)

This cognitive view of conditioning is in sharp contrast to the emphasis traditionally placed on factors such as repetition and forward contiguity between associated CS-US events. Although factors like these are important, they are not sufficient alone to explain the laboratory findings reported by Rescorla and other contemporary investigators studying classical conditioning.

Information Provided by the Conditioned Stimulus About the Unconditioned Stimulus

As already discussed, more information is derived from the regular concurrence of the CS and US than simply the probability of the US. Besides calculating event probability, classical conditioning also yields information about the size and type of anticipated stimulation. According to Rescorla, the size or magnitude of the CR depends on the associative strength acquired by the CS together with the stimulus intensity of the original US. For instance, a CS paired with an electric shock will yield a stronger avoidance response than a similar CS paired with a light slap on the hands. Additionally, the magnitude of the CR is influenced by the salience of the eliciting CS. For instance, a softly spoken reprimand will yield only a small response from a dog, whereas the same signal spoken more loudly will elicit a correspondingly larger effect.

The context or situation where the CS occurs has a significant bearing on the magnitude of the CR elicited. Dogs, like children, can easily discern that "No" in one situation does not necessarily mean the same thing as it does in another. Dog owners exhibit predictably different behavior regarding the application of punishment, depending on the social milieu current at the time of the offending misbehavior. Dogs learn that "No" when guests are around only infrequently leads to the actual occurrence of the threatened outcome—an event that would more likely occur if guests were not present. Under such conditions, guests represent a *safety signal* informing dogs that the warning will not likely be followed by actual punishment. The lesson dogs learn here is that displaying unwanted behavior in the presence of guests is safe. Such mixed messages and differential treatment lead dogs into a frustrating and confusing game of probabilities and risk.

An interesting effect of context can be observed by comparing the speed and ease of acquisition taking place in a familiar environment versus an unfamiliar environment. New learning is most easily introduced within a familiar environment. However, at the point where the learning curve begins to flatten, further (sometimes dramatic) progress is easily achieved by moving the training activity into less familiar surroundings. This observation supports the opinion of many professional trainers that introductory training should be carried out first in the home and subsequently reinforced in a group setting.

Assumptions Derived from the Rescorla-Wagner Model

Classical Conditioning (S-S Theory)

Defined: Learning about stimuli or signals predicting the occurrence or nonoccurrence of significant events.

Three possibilities exist for each presentation of the CS:

1. The CS becomes excitatory.
2. The CS becomes inhibitory.
3. The CS exhibits no change.

The model attributes significance to an animal's *expectations* regarding anticipated stimulation, especially with respect to predictions about the occurrence or nonoccurrence of the US. However, the CS also makes predictions about the impending US, including its relative salience or intensity:

1. If the US is larger (i.e., more attractive or aversive) than expected, then excitatory conditioning of the CS occurs.
2. If the US is smaller than expected, then inhibitory conditioning of the CS occurs.
3. If the US is identical to the animal's expectation, then no additional conditioning takes place.

These predictions generate the following hypotheses concerning the S-S theory of learning:

1. An animal's ability to form accurate expectations regarding the size or intensity and type of the US event presumably entails that the CS and US are centrally linked through associative and cognitive processes. Through conditioning, a neural link or pathway is produced between the CS center (e.g., auditory center in the case of tone stimuli and visual center in the case of light stimuli) and the US center (appetitive center in the case of food and fear center in the case of aversive stimulation).

2. The strength of association between the CS and US is relative to the size or intensity of the expected US. For example, the word "Good" (CS) paired with a large and delicious portion of food (US) will generate a stronger associative link between the CS "Good" (auditory center) and US food (appetitive center) than if the US presented were a small bit of stale bread. Of course, the relative effect of US size and type on associative strength will depend on the animal's degree of deprivation or satiation, as well.

3. The size or intensity of the US ultimately determines the strength or weakness of the CS-US association. When conditioning is complete (asymptotic), the strength of the association will be directly proportionate to the size or intensity of the US.

Example 1: CS (light) is paired with shock (US)

Characteristics of the US: The associative strength (S) supportable by the US at asymptote is arbitrarily denoted as superscript 1 (i.e., the amount of shock delivered). S^1, therefore, represents the actual size of the US (shock stimulus) presented.

Characteristics of the CS: The expectancy (E) is derived from the associative strength existing between the CS and US, that is, between light (^{L}) and shock (S^1). $E^{(L)}$ represents an expectation that has been formed by the association of the CS (light stimulus) occurring regularly and contiguously with the US event. Over the course of conditioning, predictions made by the animal [$E^{(L)}$] will gradually come to approximate or match the actual US event (S^1).

Example 2: Pairing a compound CS (light and tone) with a US,

$E^{(L)}$ = the associative strength of the light stimulus
$E^{(T)}$ = the associative strength of the tone stimulus

Over the course of several conditioning trials in which $E^{(L)}$ and $E^{(T)}$ are presented together in the presence of shock, both stimuli will increase in associative strength. However, neither the light CS nor the tone CS will independently progress to the associative strength supported by shock (S^1). In the case of compound conditioning, the sum of the two, that is, $E^{(L)} + E^{(T)}$, upon reaching asymptote, will approximate the associative strength supportable by shock.

1. If the auditory CS (tone) and the visual CS (light) are equally salient at the onset of conditioning (i.e., both stimuli elicit an equal orienting response), then the respective associate strengths $E^{(L)}$ and $E^{(T)}$ relative to the US will increase at an equal rate as conditioning progresses.

2. If one CS is weaker or less salient (e.g., a dim light versus a loud tone), the stronger of the two stimuli will obtain more associative strength relative to the US. Nonetheless, at asymptote, the sum of $E^{(L)}$ and $E^{(T)}$ will approximate, but not exceed, the value of S^1.

Acquisition, Extinction, and Asymptote (Fig. 6.5)

1. *Acquisition* occurs when S (associative strength supportable by the US) is greater than E (CS expectancy)—that is, the US is underpredicted by the CS, resulting in excitatory conditioning (the CS increases in associative strength relative to the US).

2. *Extinction* occurs when S is less than E—that is, the US is overpredicted by the CS, resulting in inhibitory conditioning (the CS decreases in associative strength relative to the US).

3. *Asymptote* occurs when S is equal to E—that is, the US is well predicted by the CS, resulting in no additional conditioning (the associative strength of the CS is verified relative to the US).

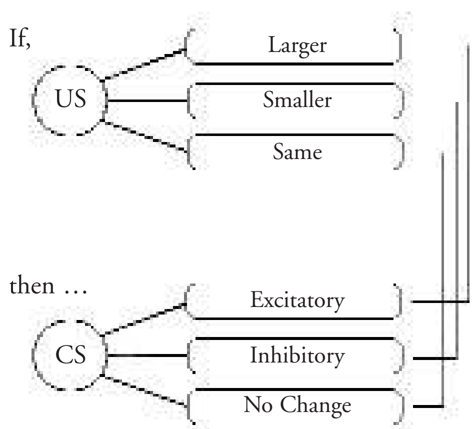

FIG. 6.5. Relationship between expectancy and classical conditioning. CS, conditioned stimulus; US, unconditioned stimulus.

Stimulus Factors Affecting Conditioned-Stimulus Acquisition and Maintenance

External Inhibition and Disinhibition

Even after a CS has been well established, it may undergo further potentiation or attenuation under the influence of various internal and external events impinging on the central mechanisms controlling it. Both excitatory and inhibitory conditioned stimuli are subject to such change. Dramatic examples of external inhibition and disinhibition can be observed among dogs fearful of loud noises or subject to separation distress when left alone. During thunderstorms or fireworks, such dogs are often overcome with fear and may lose control of many previously well-conditioned habits. A startling noise may cause otherwise well-trained dogs to pull frantically out of harm's way, even though danger never actually threatened them. Dogs reactive to separation may lose control of bladder and bowel functions, howl and bark continuously, or become destructive toward owner belongings. The effects of external inhibition or disinhibition can never be entirely eliminated. Well-trained dogs should be *proofed* against these influences through graduated exposure to diverse environments and by training them under progressively stressful conditions.

Conditioned Inhibition

Once a CS reliably predicts the occurrence of the US, it becomes an excitatory stimulus (CS+) for response properties controlled originally only by the US. Opposing inhibitory conditioning occurs when the CS is presented in the absence of the US. The inhibitory CS (CS−) predicts the nonoccurrence of the US. For instance, if a dog is differentially exposed to a light that always precedes food and a tone that always precedes the omission of food, the light will become an excitatory stimulus (CS+) for food and the

tone an inhibitory stimulus (CS–) predicting the absence of food. Later, if the experimenter decided to reverse this arrangement by making the tone predictive for food instead of signaling its omission, the dog would learn this contrary association much more slowly than if the stimulus were neutral. This impediment results from previously learned stimulus associations competing with current training efforts. Dogs must first unlearn what they have already learned about the tone (i.e., the tone must first be disconfirmed as a predictor of no food) before it can become an excitatory stimulus predicting the presentation of food.

Pavlov studied conditioned inhibition as a phenomenon occurring between excitatory and inhibitory conditioned stimuli. Conditioned inhibition occurs when a previously acquired excitatory CS is presented in combination with an inhibitory CS. Take, for example, a dog that has been trained to respond to a bell as a CS for food. On all occasions when the bell is presented alone, it is followed by food. Now consider what happens if the bell is intermittently presented in combination with a tone, but whenever the bell and tone are presented together, the food is omitted. Over time, the tone (CS−) will restrain the excitatory effects of the bell (CS+) when the two stimuli are presented together as a compound stimulus:

bell (CS+) > food::salivation
bell (CS+) & tone (CS–) > no food::
reduced salivation

The dog has learned that the presentation of a compound stimulus composed of a bell and tone stimulus predicts the absence of food. If the inhibitory tone stimulus (CS–) is now combined with some other previously conditioned excitatory stimulus (CS+), for example, a light, it will be found that the inhibitory effect obtained by presenting the bell and tone together without food transfers to control this remote CS+ (light). When the light (CS+) is presented with the tone (CS–), salivation normally elicited by the light CS+ is inhibited (Fig. 6.6).

Further, as just noted, if the tone (a conditioned inhibitor) is now paired with food to make it an excitatory CS, it is found that this is a rather more difficult process. It takes the dog longer to learn that the tone predicts food because this new association conflicts with a previously well-established contrary association—that is, the tone predicts the absence of food. This so-called *retardation of acquisition effect* can be observed in many training contexts. Dogs regularly exposed to CS events not followed by expected US events learn to treat such impinging signals and stimuli as irrelevant. Effective use of classical conditioning requires that dogs be exposed to clear and predictable occurrences of the CS preceding the US. Classical learning is never inactive: it provides inquisitive dogs with information regarding either the occurrence or nonoccurrence of important events—that is, the dogs are always learning to respond or not to respond.

Findings such as the foregoing suggest that both excitatory and inhibitory influences affect the CS. The excitatory CS (CS+) predicts the occurrence of the US, whereas the inhibitory CS (CS–) predicts the absence of the US (Fig. 6.7). These excitatory and inhibitory influences extend equally to attractive and aversive stimuli. Taken together, these various relations produce four types of classical conditioning (Fig. 6.8). Under natural conditions, the actual strength of the CS is a composite of CS+ and CS– influences, with the valence of the particular CS depending on the extent to which it predicts the presence or absence of the US.

Latent Inhibition

Repetitious presentation of a NS independently of the US results in the NS becoming associatively resistant to future classical conditioning. For example, if a dog's name is used casually (without evoking an appropriate attending response), the attention-controlling and orienting function of the name will be compromised and rendered more difficult to learn later on. Studies have shown that as few as 15 to 20 nonreinforced presentations of the NS prior to conditioning are

sufficient to produce latent inhibition (Lubow, 1973). Animals exposed to such treatment fail to attend to the stimulus because its presentation has proven to be uneventful in the past, producing a cognitive interference effect that Baker (1976) refers to as *learned irrelevance*. If a dog has inadvertently learned that the CS is irrelevant, this interfering conviction must first be disconfirmed before new learning can take place. Classical learning appears to proceed most efficiently under circumstances where a completely novel CS occurs contiguously with a startling or surprising US.

Sensory Preconditioning

An interesting conditioning phenomenon occurs when neutral stimuli are paired together prior to conditioning (Fig. 6.9). For example, if the sound of a clicker occurs just prior to the word cue "Good" over several trials, an associative connection between these signals will occur even though the arrangement is not followed by a US. Evidence for the effectiveness of preconditioned associations becomes apparent only after the CS "Good" undergoes some actual conditioning with the US (e.g., food). Once such conditioning

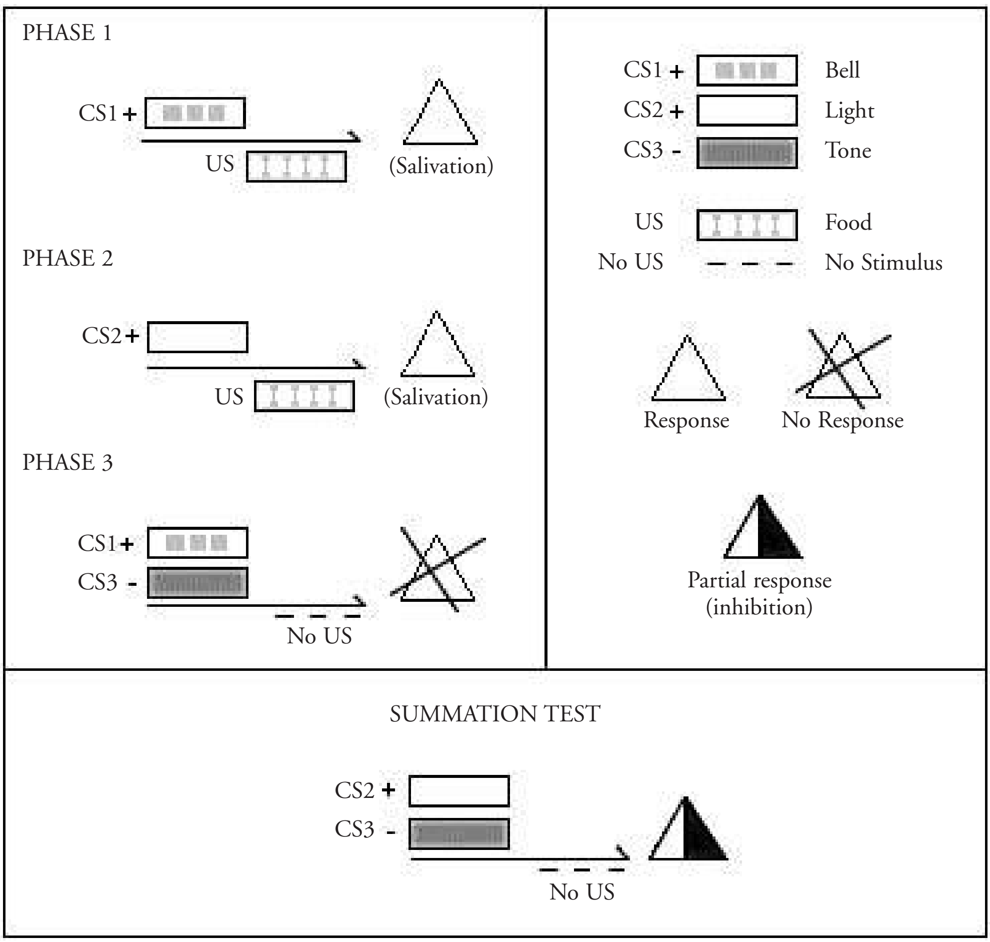

FIG. 6.6. Diagram demonstrating conditioned inhibition. CS, conditioned stimulus; US, unconditioned stimulus.

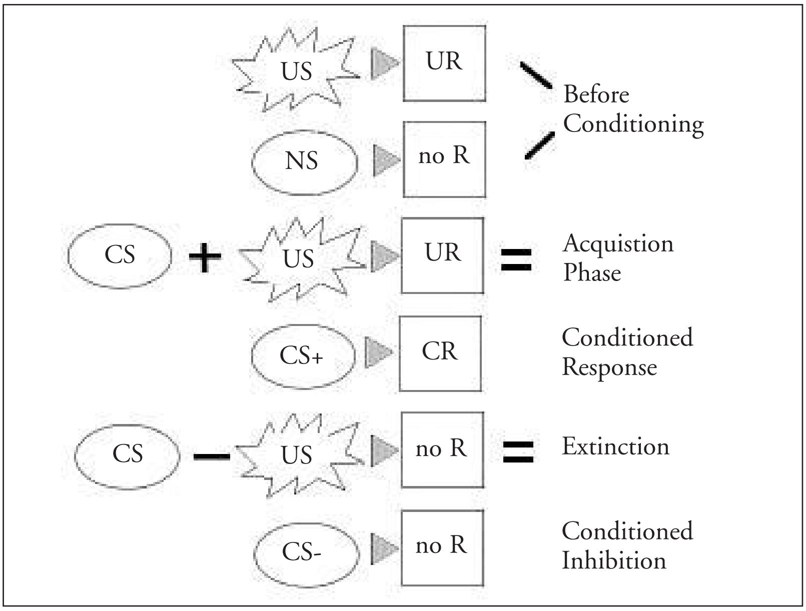

FIG. 6.7. Basic excitatory and inhibitory relations between the stimulus and response in classical conditioning. CR, conditioned response; CS, conditioned stimulus; NS, neutral stimulus; R, response; UR, unconditioned response; US, unconditioned stimulus.

CS+ Aversive excitatory	CS- Aversive inhibitory
CS- Appetitive inhibitory	CS+ Appetitive excitatory

FIG. 6.8. Matrix showing the four basic types of classical conditioning. CS, conditioned stimulus.

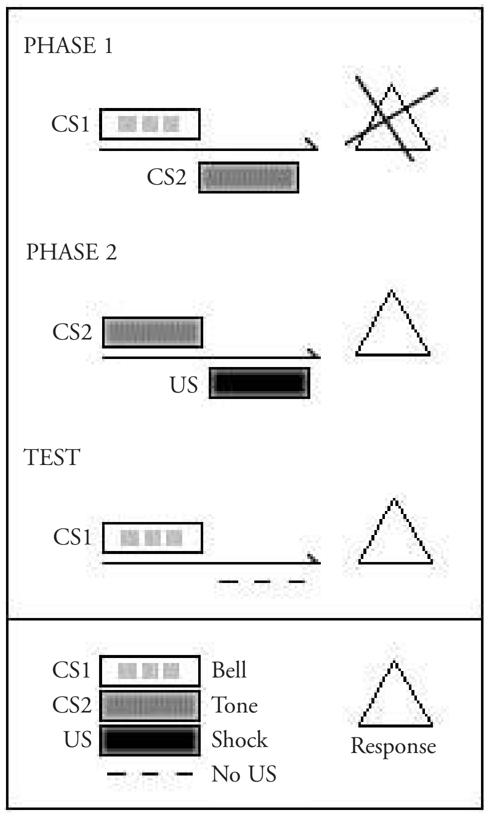

FIG. 6.9. Sensory preconditioning. CS, conditioned stimulus; US, unconditioned stimulus.

takes place, the clicker (which had not been previously paired with the US) spontaneously acquires associative strength derived through its previous presentation with the word cue "Good." This phenomenon readily occurs even in cases where the delay between the two preconditioning stimuli is as long as 4 seconds and after as few as 4 or 5 trials (Prewitt, 1967).

Conditioned Compound Stimuli

The concurrent conditioning of more than one stimulus at a time has received a great deal of experimental attention. If two stimuli are paired simultaneously with a single US, both will share a portion of the acquired associative strength and predictive value. The amount of the portion acquired is determined by many factors. Certainly, a stimulus affected by conditioned or latent inhibition will get a lesser portion than a novel stimulus unaffected by such opposing conditioning. Some stimuli are simply more salient and command more attention than others—that is, they *overshadow* less salient stimuli with which they happen to occur (Fig. 6.10). In practice, the effect of overshadowing can be observed by raising or changing the tone of voice, which has the immediate effect of focusing a dog's attention by overshadowing other competing interests. A phenomenon known as the *blocking effect* occurs when one of the combined stimuli has already undergone previous conditioning with the US. That is, the previously established CS will block conditioning of the NS with which it is combined (Kamin, 1968) (Fig. 6.11).

Surprising effects sometimes occur when previously conditioned stimuli are presented together. For example, Woodbury (1943) trained dogs to lever press for food in the presence of a low-pitched buzzer sound and a high-pitched buzzer sound. In the presence of either of these stimuli, lever pressing was reinforced with food, but when both signals were presented together, food was never delivered when lever pressing occurred. The dogs consequently learned to lever press when either of the two signals were presented separately but refrained from responding when both signals were presented together. This finding is a little odd, since one would expect, if both the low-pitched and high-pitched buzzer sounds produce responding, that when both sound stimuli are presented together, responding should still occur. What appears to occur, however, is the formation of a distinct compound configuration composed of elements derived from both stimuli but sufficiently different from each to be easily discriminated and associated with the absence of reinforcement.

Higher-Order Conditioning

Once a CS has been established, it can be used to condition other stimuli to elicit the CR. This is accomplished by pairing the new stimulus with the CS but omitting the presentation of the US (Fig. 6.12). The previously conditioned stimulus takes the place of the US in this arrangement. In comparison to the associative strength acquired through

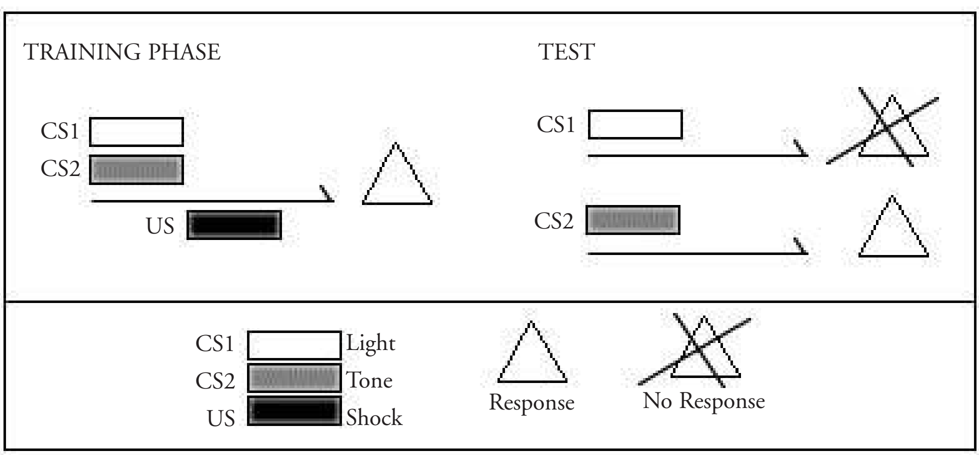

FIG. 6.10. The absence of conditioning in the case of the light stimulus (CS1) suggests that the tone (CS2) has a greater salience and overshadows the light stimulus when both light and tone are presented together as a compound stimulus. CS, conditioned stimulus; US, unconditioned stimulus.

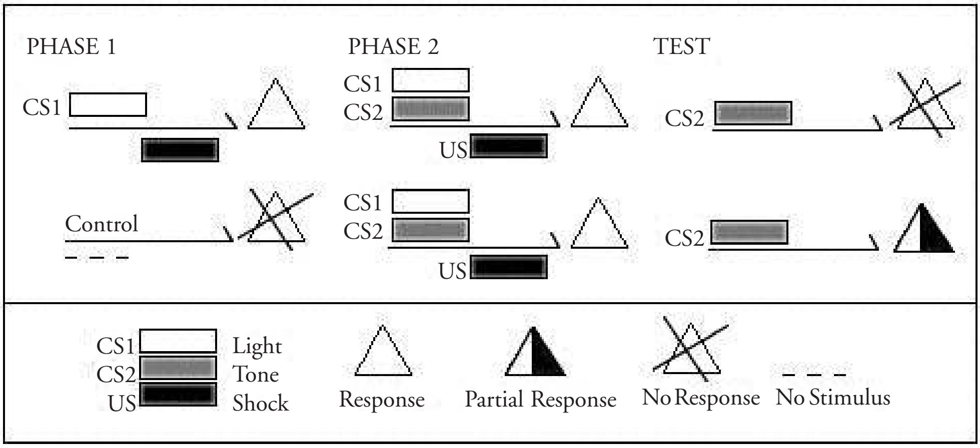

FIG. 6.11. Kamin's (1968) blocking effect. Note that previous conditioning of the light stimulus blocks acquisition of conditioning of the tone stimulus when the tone is presented together with the light. However, when the light and tone are presented together as neutral stimuli, the tone rapidly acquires the ability to produce the conditioned response (CR)—given that it is not *overshadowed* by the light. CS, conditioned stimulus; US, unconditioned stimulus.

first-order conditioning, higher-order conditioning is relatively weak. Pavlov was not able to establish appetitive excitatory conditioning beyond the second order, although aversive excitatory conditioning was taken to the third order when shock was employed as the original US (1927/1960). Although the existence of higher-order conditioning is of great importance theoretically, it has limited practical use in dog training. An area where it may have important implications is in case of phobic stimuli. Over time, the phobic-stimulus complex may widen to include remote stimuli not originally belonging to the traumatic situation itself. This extension of fear beyond the immediate fear-conditioning situation may be in part due to the effect of second-order conditioning taking place between the original CS and various novel stimuli with which it subsequently happens to come into regular contact.

GENERALIZATION AND DISCRIMINATION

An important property of the CS and CR is known as generalization. *Stimulus generalization* and *response generalization* provide the

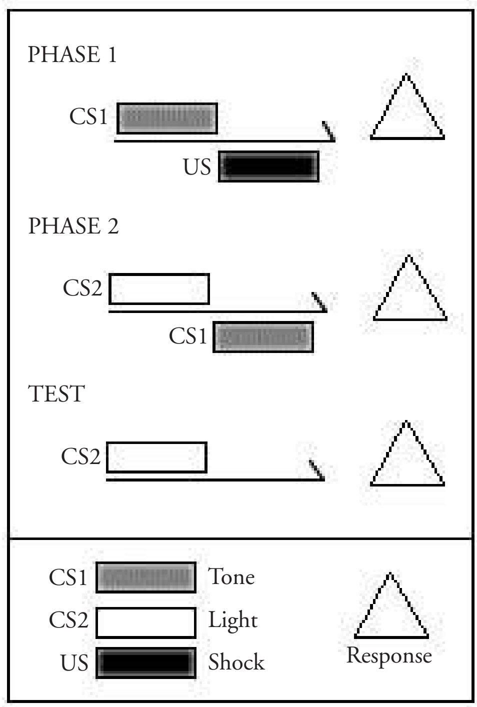

FIG. 6.12. Diagram of second-order conditioning. CS, conditioned stimulus; US, unconditioned stimulus.

means whereby information derived from one situation is made useful in others that are not exactly the same. Under natural conditions, animals are rarely exposed to identical stimulus events or situations; thus, the ability to generalize is a vital adaptation. Dogs easily generalize from one safe encounter with an object to many others sharing similar stimulus features. Similarly, startling or dangerous encounters are generalized with even greater facility over many objects, sometimes only remotely similar. Phobias and fears are extended by generalization to include a large number of objects and situations not directly associated with the original trauma. The ability to generalize enables the animal to draw conclusions about a whole set of objects and situations without having to take the time to test each one. However, such generalizations may not hold in at least two directions: (1) Not all items sharing known safe characteristics are actually safe. (2) Not all items sharing known dangerous characteristics are actually dangerous. For example, a puppy in the habit of tugging and chewing on its leash might generalize the safety of such activities to electrical cords. The electrical cord is similar in many ways to the leash, except for one very serious difference. If the puppy is tempted and unfortunate enough to get shocked by the cord, it will quickly learn to discriminate the cord from leashes and other items sharing a similar appearance. Yet, another possible consequence of the puppy's experience might occur—the development of a fearful generalization about items sharing characteristics belonging to electrical cords. In this case, the second excess of generalization may ensue. The puppy may now incorrectly consider all items sharing characteristics belonging to electrical cords as dangerous and consequently exhibit inappropriate fear toward leashes, ropes, strings, ribbons, and the like. Only through additional experience and discrimination learning will the puppy find that such items are different from electrical cords and gradually regard them as being safe. In contrast to stimulus generalization, response generalization refers to the concurrent elicitation of similar responses to the one being explicitly conditioned. Such generalization results in a loss of specificity but increases, within the confines of adaptive limits, the range of behavioral variability available to the animal.

Generalization and discrimination processes play an active role in all training activities. For example, the process of developing a conditioned reinforcer can be adversely affected by unanticipated generalization effects. A dog that has been trained to respond to the word signal "Good" as a positive conditioned reinforcer will also respond to great many other word cues spoken in a similar tone of voice. It is important, therefore, to differentiate clearly the reward cue from other voice signals used in training. Usually, a higher-pitched tone of voice is used to sound the reward cue, whereas a lower, more assertive tone is used to sound the reprimand or negative conditioned reinforcer. An alternative is to choose a conditioned reinforcer that is highly distinct and unique (e.g., a clicker or whistle).

Discriminative stimuli (S^D) or *command cues* are customarily spoken in a normal tone of voice. Stimulus control is established by training a dog to expect reinforcement to occur if it responds appropriately in the presence of the command cue. In cases where a specific command cue needs to be discriminated from other similar verbal sounds, explicit discrimination training efforts may be needed. During such training, the range of generalization and potential confusion is reduced by selectively reinforcing only responses occurring in the presence of the specific command cue or S^D. Responses occurring in the presence of similar (generalized) verbal cues are either blocked (response prevention) or extinguished by withholding reinforcement if they happen to occur. For example, in the case of the command cue "down," verbal sounds similar to "down" are presented (e.g., found, town, pound, clown, and sound) while unwanted down responses are prevented from occurring or simply not reinforced, that is, they are extinguished. This discussion anticipates a more thorough treatment of the topic of stimulus control and instrumental learning that is covered in Chapter 8.

Extinction of Classical Conditioning

Stimulus-response associations established through classical conditioning can be weakened by a process called *extinction*. If the occurrence of a CS is not regularly followed by the presentation of the reinforcing US, the associative bond between the CS and US will deteriorate. After many such nonreinforced trials, the CS will fail to elicit the CR—that is, the CS has been extinguished. For example, saying "Good" without occasionally following it with an actual reward will result in its extinction—that is, the dog will learn to ignore the bridging stimulus. Remember that the CS serves to predict future events. Whenever the CS fails to predict the accustomed US, it will begin to forecast the opposite—the absence of the US. In the case of the reprimand, habitual failure to follow the reprimand cue with an actual punitive event may inadvertently teach a dog to interpret the reprimand as a safety signal—a very undesirable outcome. Unfortunately, the typical learning experience of many dogs is one in which they are exposed to a stream of nonreinforced presentations of significant cues (essentially empty warnings and bribes) occurring independently of actual outcomes.

Spontaneous Recovery and Other Sources of Relapse

Extinction is subject to *savings*, that is, influences from previous learning that persist and interfere with the permanent uncoupling of the associative link between the CS and US (Kehoe and Macrae, 1997). Despite many previous extinction trials, the CS may spontaneously recover and elicit the previously extinguished CR. In practice, the extinction process serves only to reduce the future occurrence of the CR, not eliminate it. The persistence of classically conditioned behavior is particularly evident and problematic in the case of fear conditioning, phobias, and aggression.

In addition to spontaneous recovery, the classical conditioning phenomenon known as *disinhibition* can interfere with extinction efforts. Disinhibition occurs when a startling or surprising event (a distraction sufficient to elicit an orienting response) is presented together with the extinguished CS. As a result of this arrangement, conditioned responding to the CS spontaneously reappears in spite of many previous extinction trials. Under natural conditions of dog training, these sorts of disinhibitory influences are impossible to avoid entirely, requiring instead that they be proofed against as part of the training process.

Several other sources of relapse have been identified in addition to spontaneous recovery and disinhibition (Bouton and Swartzentruber, 1991): renewal, reinstatement, and reacquisition.

Renewal

Renewal refers to the effect that a change of context has on the extinction of a CR. Contextual cues play a significant role in the learning and unlearning of behavior. In the typical renewal experiment, a conditioned fear response is first trained in one context and then extinguished in another. When the animal is placed back into the original context, the extinguished fear response is strongly renewed despite the intensive extinction efforts. Another variation on the renewal experiment involves testing the animal after extinction in a novel context. Fear is renewed in the novel context even though no previous conditioning has actually taken place there. These sorts of experiments indicate that the animal learns to express or inhibit fear depending on the degree of safety or danger associated with the situation—that is, extinction is to a significant extent context dependent.

Reinstatement

Reinstatement of an extinguished CS occurs when the original US is presented in the absence of the CS. Later (after a day or more), the CS is tested and found to have recovered its ability to elicit the previously extinguished CR. The reinstatement effect plays an important role in the recovery of phobias. For example, a dog exposed to a particularly fearsome sample of thunder may

recover previously extinguished fear-eliciting conditioned stimuli associated with thunder (overcast skies, barometric pressure changes, and distant lightning flashes).

Reacquisition

Recovery effects are also evident during reacquisition training. When a previously extinguished CS is paired again with the US, the recovery of responding is much more rapid than when a NS is paired with the US. The degree of recovery during reacquisition training depends on the context and associated renewal effects. Contexts that have been associated with past aversive training tend to produce more rapid and robust reacquisition, whereas contexts that have been associated with safety tend to retard reacquisition.

These various recovery phenomena indicate that extinction does not entirely erase the associative link formed between the CS and US or degrade the encoded memory of previous emotional conditioning. Instead of being conceived as a means for erasing past learning, extinction is best interpreted as an active learning process, incorporating and consolidating previously acquired associative information about the CS and US with new input from the environment. As such, extinction is dependent on both stimulus-specific associations between the CS and US, as well as contextual *occasion setting* cues. Learning about specific stimulus relationships and the contexts in which they occur provides the organism with a flexible and discriminating associative interface with biologically significant events.

Habituation and Sensitization

Habituation is a nonassociative learning phenomenon that is often confused with extinction. Extinction results when the CS fails to predict the occurrence of the associated US, that is, the CS no longer elicits the CR. In contrast, habituation occurs when the US is repeatedly presented until the associated UR is no longer elicited. For instance, the occurrence of a strange loud noise will evoke a vigorous orienting response from most dogs. However, if the noise is repeated many times, dogs may learn to ignore it. In effect, they have learned that their original reaction is no longer appropriate, determining that the noise is irrelevant to them and that it can be safely ignored. If subsequently exposed to the same noise a day or two later, the dogs' reaction will have probably returned to nearly the same strength as it was prior to habituation. This effect is known as *spontaneous recovery*. Spontaneous recovery affects both habituated URs and extinguished CRs.

Sensitization produces the opposite effect of habituation. The sensitization effect is produced by exposing dogs to an intense sample of the US sufficient to elicit a startle or surprise reaction. Subsequent exposures to the US at lower intensities (perhaps previously ignored) will produce a noticeable increase in UR magnitude. Another method for sensitizing dogs to a US of low salience is to pair it with a different US of stronger intensity. Such US-US pairings are very useful in dog training. For instance, the vocal reprimand, while possessing some surprise/startle properties, is easily fatigued through repeated use but may be potentiated by being presented simultaneously (compound conditioning) with a startling US like the toss of a shaker can. Sensitization techniques are especially useful in training situations involving avoidance conditioning and aversive counterconditioning.

Special Phenomena of Classical Conditioning

Classical conditioning usually depends on repeated contiguous pairings of the CS with the US. There exist, however, several examples involving classical conditioning that appear to violate these basic requirements: pseudoconditioning, one-trial learning, taste aversion, and imprinting. Another classical conditioning phenomenon not fitting neatly into the Pavlovian paradigm is what Solomon and Corbit (1974) has termed *opponent processing*, a special case of hedonic conditioning having pronounced (theoretical) effects on emotional learning and reactivity.

Pseudoconditioning

Pseudoconditioning is usually observed in classical conditioning situations, especially as a confounding influence that must be experimentally controlled against. As just discussed, the normal relationship between the CS and the US in Pavlov's paradigm depends on the forward and contiguous presentation of the CS followed by a US—a CS-US arrangement referred to as *pairing*. After repeated pairings (although sometimes one is enough), a conditional association between the two stimuli is established, so that the previously neutral stimulus (now a CS) is capable of eliciting a CR resembling the UR that had been originally elicited only by the US. In pseudoconditioning, the stimulus (neutral) elicits a response resembling a UR, even though it has never been paired with the US.

For example, if a dog receives an intense shock delivered by an electronic collar and then a few hours later a buzzer sound is delivered by the same collar, the dog may react to the sound as though it had been actually shocked rather than just buzzed. This behavioral change occurs even though the buzzer was never actually paired with shock in the past. The buzzer apparently acquires CS-like properties through sensitization and other association effects that do not strictly belong to the classical conditioning paradigm. In fact, any strong surprising or startling event may cause *pseudoconditioning*, that is, evoke responses to neutral stimuli that have never been paired with the eliciting US. Another important factor in the foregoing example is *generalization*—that is, the vibrating buzzer may seem similar in some particulars to shock, thus facilitating a connection between the two stimulus events. However, the similarities between the shock and buzzer sound are not the only factors involved. Although generalization is often present in pseudoconditioning, an even more important consideration is *context*. In the present instance, the buzzer occurs in close association with the source of electrical stimulation, with both stimuli being produced by a collar fastened around the dog's neck.

As the result of a particularly aversive event, the context in which the incident occurs may itself become conditionally linked to the aversive experience. When under the influence of a similar situation in the future, the dog may be more vigilant and alert for danger, exhibiting a much lower threshold for startle or escape behavior. Now an otherwise innocuous event may elicit a strong fear response (as occurs, by the way, in post-traumatic stress disorder and is commonly observed in abused dogs). For example, if a dog is attacked by another dog while out on a walk, on future occasions while walking in that same general vicinity at about the same time of day the dog may appear to be more cautious and defensive about its surroundings. Sounds and movements that might be ignored in other places now take on a new significance. A passing car with a loud muffler or a pile of leaves shifting abruptly in the wind might evoke a strong startle or panic reaction, even though there is no actual threat (past or present) associated with such occurrences themselves. For trainers working with emotionally motivated behavior problems (e.g., aggression, fears, or separation distress) behavioral effects associated with pseudoconditioning should be carefully assessed and taken into consideration when developing behavior modification programs.

One-Trial Learning

Many chronic phobias can be traced to a single event. There appear to be hardwired neurobehavioral mechanisms designed to facilitate rapid learning of information derived from particularly dangerous experiences or startling stimulus events. Under natural conditions, life-threatening or potentially injurious situations may not offer an animal the luxury of repeated exposures or close encounters in order for it to learn that the stimulus in question predicts danger. Consequently, some avoidance patterns appear to be innately programmed or prepared in advance so that they are easily learned with minimal exposure to the threatening situation (Seligman, 1971). Such preparedness is a natural safeguard, al-

lowing the animal to identify especially dangerous associations quickly and efficiently without depending on repeated exposure.

One-trial learning frequently results when a strongly startling or threatening US is paired with a novel CS. The operative word here is *novel*. Positive or neutral past experiences (latent learning) with the CS may interfere with one-trial learning. This interference effect stems from competitive *safe* expectancies that must first be disconfirmed before new learning can take place. Many arrangements provide sufficient conditions for one-trial learning, but it is optimally evoked in situations where the environment itself produces the desired effect. For example, a puppy that has developed the dangerous habit of chewing on electrical cords can be discouraged by preparing electrical cords so that an intense startle or aversive event occurs whenever they are disturbed. A common method employed for this purpose is to booby trap the forbidden item so that an intense startle is produced if the cord is disturbed. The resulting effect provides a lasting aversive association and avoidance of electrical cords.

Taste Aversion

Taste aversion is another example of associative learning that does not fit neatly into the classical conditioning paradigm. A lasting taste aversion often results when an animal ingests a food item or flavor that is followed by a nausea-producing illness. As previously discussed in Chapter 5, Garcia and colleagues (1966) performed a series of experiments in which rats were presented with a compound stimulus involving flashing lights and noise while drinking saccharine-flavored water. While drinking the flavored water, the rats were simultaneously exposed to radiation. Such exposure to radiation causes nausea within an hour or so. Subsequent testing revealed that the exposed rats had developed an intense aversion toward the taste of saccharine but not toward the auditory and visual conditioned stimuli employed. A curious feature of taste aversion is that the effect can be produced even if the inducement of nausea is delayed for several hours. Also, taste aversions can be reliably established after only a single trial. The conditions under which taste aversions are established are inconsistent with the requirements normally present during classical conditioning, that is, *repeated contiguous* pairings of the CS and US. There appear to exist special learning sensitivities connected with taste and nausea, aiding some animals in differentiating safe from poisonous food items. Seligman (1970) has postulated an internal *preparedness* facilitating the learning of such associations. Taste-aversion techniques have been used effectively to discourage predation on sheep by coyotes (Gustavson et al., 1974; Garcia et al., 1977). It makes biological sense that a foraging animal would evolve strongly prepared sensitivities for the development of taste aversions. As in other examples of one-trial learning, the food item being conditioned must be *novel,* that is, lack a history of safe ingestions. Food safely ingested in the past may require nausea-producing exposures before it is avoided.

A taste aversion procedure may be useful for controlling refractory coprophagia. Eating feces is a common canine vice, and, though not usually harmful to the offending dog's health, it is aesthetically objectionable to many owners. In cases where everything else fails, a taste-aversion arrangement might prove helpful (Houpt, 1991), although such methods have not been demonstrated consistently effective in dogs (Hart and Hart, 1985). The procedure is simple: as soon as the dog ingests feces, the owner is instructed to induce vomiting with a chemical emetic. Sometimes the feces itself is contaminated with the emetic. Gustavson (1996) has noted, however, that emesis per se is not sufficient to establish taste aversion, suggesting that common emetics such as ipecac are inappropriate for establishing such learning. The critical factor involved here is that the chemical being used is capable of eliciting nausea, that is, producing sensations of physical illness. One of the most common compounds employed to achieve this end is lithium chloride. Gustavson and coworkers have recommended the

use of taste-aversion procedures for controlling a variety of appetitive vices and excesses. In spite of the potential benefits of taste aversion, such treatment is not without potential risks, side effects, and discomfort for dogs. Consequently, the method should be performed only under close veterinary supervision and reserved as a last-resort treatment for serious and refractory appetitive behavior problems.

Imprinting

Konrad Lorenz, credited with the discovery of imprinting in birds, early expressed the opinion that imprinting was not a learning phenomenon but an instinctive process of attachment to a social object: "This process cannot be equated with learning—it is the acquisition of the object of instinctive behavior patterns oriented toward conspecifics" (1970:124). Subsequent study, however, has shown that a great many classical conditioning factors do play a role in the imprinting process (Sluckin, 1965). Imprinting may be interpreted as a variant form of classical learning in which several behavior patterns, attachments, and preferences are facilitated through brief exposures early in life. Imprinting is unique in that it takes place most efficiently (if at all) during narrowly defined sensitive periods occurring early in the animal's life. If this period of sensitivity passes without the occurrence of appropriate stimulation, then irreversible adjustment problems may develop (Scott and Fuller, 1965).

Imprinting is distinguished from most forms of classical conditioning along several different dimensions: speed of acquisition, permanence of associations, resistance to future learning effects, resistance to decay by disuse, and the reliance on sensitive periods early in life. Another significant difference between imprinting and other forms of classical conditioning is that imprinting often involves complex behavior patterns, whereas most other stimulus learning involves more simple and discrete units of behavior. Studies designed to determine whether imprinting and social attachment involve instrumental components have demonstrated that positive reinforcement (food rewards) does not play a significant role (Brodbeck, 1954; Scott, 1962). In fact, the effects of imprinting appear to be enhanced by conditions adverse to instrumental learning. Animals appear to be even more strongly attracted to the imprinted object when they are forced to endure obstacles and aversive stimulation during the imprinting process (Hess, 1964).

Classically Generated Opponent Processes and Emotions

Emotional states are complicated and cannot be adequately explained by the simple associative model of classical learning. The Pavlovian model only accounts for responses occurring contiguously with the presented stimulus. But, actually a chain of stimulus-response events takes place, composed of some aspects that are not only inconsistent with the originally elicited response but actively antagonistic to it (Solomon and Corbit, 1974). According to the opponent-process theory, elicited emotional states (*a-processes*) are simultaneously counteracted by diametrically opposed affects (*b-processes*), a sort of affective shadow that remains outside of conscious awareness during active stimulation (Fig. 6.13).

According to Solomon and Corbit, opposing b-processes serve to maintain emotional balance and equilibrium by guarding against potentially overarousing stimulation from either hedonically pleasurable or aversive a-process experiences. The magnitude of any emotional response is regulated by a summation of interactive components from both a-process and b-process affective input. This opponent processing determines the animal's state of emotional arousal at any given moment. If affective states were not balanced by concurrent counterpoised opponent processes, emotional stimulation would be chaotic and uncontrollable. Instead, each a-process emotion is counteracted as it occurs by an antagonistic emotional b-process shadowing it. Opposing b-process aftereffects are consciously experienced only after the source of a-process stimulation is withdrawn. For example, if the reader were to pinch himself or herself briefly and then observe introspectively the affects attending the cessation of

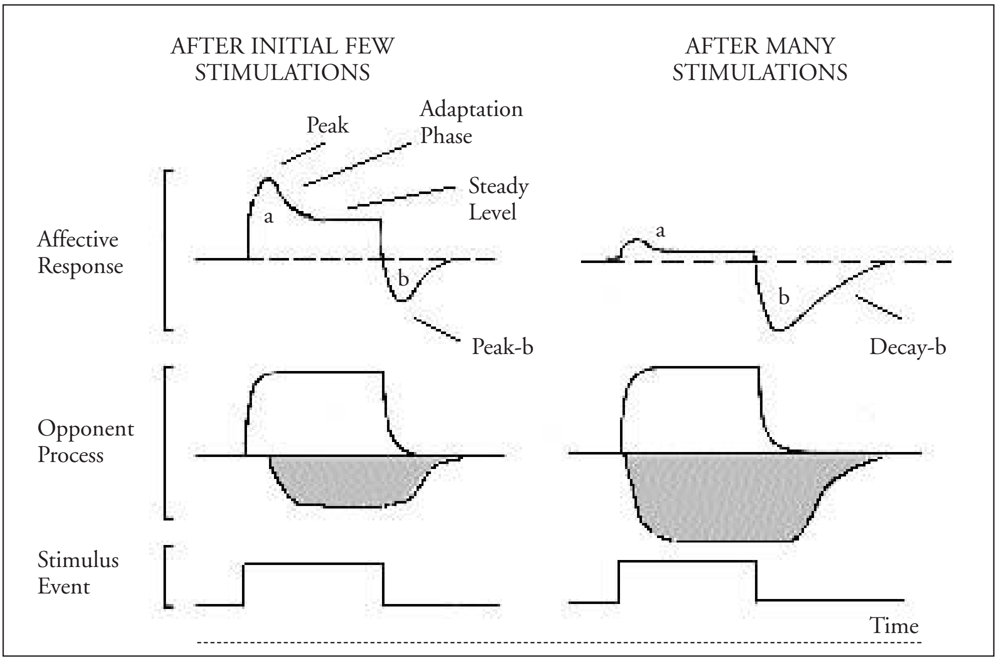

FIG. 6.13. Opponent-process effects resulting from emotion-eliciting stimulation. After Solomon and Corbit (1974).

pain, he or she would probably note a subtle, yet distinctively pleasurable, emotional aftereffect contrasting with the previous pain. In this case, the painful pinch (a-process) is followed by an opposing pleasurable sensation (b-process) when the pinch is terminated. Another interesting example of opponent processing occurs in vision involving color afterimages. If one steadily looks at a patch of color and then turns abruptly away focusing on a white wall, slowly the color's opposite or complement begins to appear.

A-Process and B-Process Attributes

A-processes and b-processes are contrasted on several dimensions. The following is a brief inventory of some of these differences.

A-Process Attributes

1. A-process affects are immediate and contiguous with the stimulating event.
2. A-process affects pass through three basic phases: a peak of emotional stimulation, followed by an adaptation phase, and finally leveling off into a steady state.
3. Once emotional stimulation is terminated, a-process reactivity quickly returns to baseline levels (denouement).
4. Repeated stimulation of a-process reactions results in their weakening (habituation).

B-Process Attributes

1. Opponent b-process reactions are sluggish both in terms of initiation and decay.
2. Opponent b-process affects are entirely reactive, opposing a-process stimulation.
3. Opponent b-process affects are overshadowed by the a-state until stimulation is withdrawn.
4. Repeated stimulation results in the strengthening of b-process affects.

Practical Application of Opponent-Process Theory

Theoretically, whenever any hedonically significant event (producing pleasure or pain)

takes place, both a-processes and b-processes are mobilized. Several interactive factors influence the final outcome and the relative strength of these opposed states. One of the most important of these factors involves the effect of repeated use. Frequent stimulation weakens a-process emotions while simultaneously strengthening b-process aftereffects. After frequent stimulation of a-process emotions, the b-process aftereffects begin to occur more rapidly and the denouement to baseline levels requires a much longer time to occur.

These various effects of frequent stimulation may be at work in a common behavioral disorder: separation anxiety. Separation-anxious dogs and puppies are unable to cope calmly with owner departures and separations (Voith, 1981). Instead of passively accepting such periods of loneliness, separation-reactive dogs become overly anxious (panic) and act out in a variety of destructive or maladjusted ways. Dogs predisposed to separation anxiety are typically highly dependent, exhibit excessive attention needs, are overly sensitive, and are prone to develop compulsive behavior disorders.

Opponent-process theory interprets attachment and separation-distress reactions in terms of a-processes and b-processes (Hoffman and Solomon, 1974). When a separation-anxious dog is with its human companion, the dog is comforted by social contact and security, but when the owner departs, the separation-vulnerable dog becomes distressed and worried. Even though apparently fully at ease when the dog is with the owner, actually underlying opposing b-process affects are already being generated, offsetting and balancing a-process affections and attachments. These opposing b-process emotions do not become obvious until after the owner departs, when shortly thereafter the dog is overwhelmed with fears of abandonment and loss of security. After many subsequent trials, a-process stimulation begins to wane, losing its ability to support the separation-anxious dog's growing attachment needs even when the owner is present.

The consequence is nervous or anxious attachment, a condition of perpetual social attention seeking and contact neediness that can never be fully satisfied (Bowlby, 1973). According to the opponent-process theory, such compensatory efforts are futile and counterproductive, since repeated stimulation of positive social affects merely causes the strengthening of underlying opposing fears of social isolation. On those inevitable occasions when the dog must be left alone, b-processed fears of abandonment and isolation will rise with even greater intensity than before, evoking ever-escalating levels of distress and panic until the cycle of attachment and fear of loss/abandonment is broken. Most separation-anxious dogs exhibit some form of nervous attachment toward their owners. To treat separation anxiety effectively, this vicious cycle of nervous attachment and panic must be systematically altered so that positive a-processed affects and attachment needs are normalized and negative b-processed anxieties are reduced through desensitization and counterconditioning efforts.

Another situation where opponent processing may play a significant role is in the case of long-term and excessive punishment. Many dog owners seek professional help only after many months of frustrated training efforts. In some cases, punishment was the primary method used to establish behavioral control. Such owners are often confused and profoundly discouraged by their dog's resistance to training. Even though routinely and severely punished, the offending dog quickly recovers and persists "doggedly" despite escalating harsh treatment. While such oppositional behavior usually involves a number of factors that need to be considered in their own right (e.g., unresolved dominance tensions, hyperactivity, and negative attention seeking), the trainer might also consider the possibility that the dog's resistance and apparent lack of responsiveness is due to the effects of frequent and excessive punishment. Punitive owners often comment on a decline in their dog's responsiveness to discipline, a progressive strengthening of general resistance and willfulness, and the development of armorlike thresholds against startle and pain. Some dogs actually wag their tails or may ex-

hibit penile erection (a consternating result for an angry owner) immediately after punishment and happily come back for more. The opponent-process theory predicts such behavioral tendencies as a result of frequent punishment.

Physical punishment usually evokes two primary reactions: fear and pain. Initial stimulation elicits strong inhibitory reactions, autonomic activation, and escape. According to opponent-process theory, subsequent stimulations become progressively weaker as they fall under the opposing influence of underlying b-processes, which are essentially the hedonic opposite of fear and pain. In the case of frequent aversive stimulation, the a-process reactions become slower and weaker while the pleasurable b-processes become faster, stronger, and decay much more gradually. Paradoxically, over time and frequent use, punishment may actually become a rewarding event, since the effect of frequent aversive stimulation is the production of highly pleasurable and sustained b-processed emotions.

A possible neurophysiological cause of this acquired immunity to punishment may be attributed to the release of endogenous opioids (endorphins) resulting from chronic stress or punishment. Watkins and Mayer (1982) demonstrated that aversive events (shock) produce lasting analgesic aftereffects involving both opioid and nonopioid systems. Such analgesia can be produced directly by the aversive event itself or indirectly via the mediation of classically conditioned stimuli associated with it. Besides stimulating an analgesic effect, endorphins exhibit several psychotropic actions, including calming and antidepressant actions, as well as reducing aggressive reactivity and general fearfulness. Drugan and colleagues (1985) found that animals exposed to uncontrollable shock develop greater and longer-lasting analgesic numbing than animals able to escape shock. Exposure to chronic stress and punishment may activate physiological dependence or addiction to endogenous opiates, *perhaps* motivating dogs to act in ways that ensure sufficient dosing. Christie and Chesher (1982) reported that both the injection of naloxone or the termination of noxious stimulation resulted in morphinelike withdrawal symptoms in their stressed animal subjects.

Counterconditioning

Pavlovian conditioning plays a vital role in the learning and unlearning of emotional reactions through counterconditioning. To resolve fears and other problems involving emotional components (e.g., phobias, separation anxiety, and aggressiveness), classical conditioning may be required. Unlike instrumental behavior, classically conditioned responses are largely autonomous and independent of central control. Dogs never consciously choose to *feel* fearful or anxious; such emotions simply come over them as automatically as such feelings may come over us. This autonomic component is mostly outside the reach of voluntary control. Despite great effort and preoccupation, people suffering with phobias are unable to control their fearful arousal when in the presence of the eliciting stimulus. The inherent resistance of highly motivated emotions to voluntary control is especially evident in the case of well-established phobias. Behavior problems involving aversive emotional components like fear and anger must be treated with a two-pronged approach utilizing both classical and instrumental training methods.

Although dogs may learn to cope with emotionally distressful stimulation, they cannot directly control the onset and offset of autonomic affective arousal, except by moving out of the range of eliciting stimuli. To be controlled, an aversive emotion (e.g., anger or fear) must be countered by the elicitation of an even stronger and incompatible emotional response. The philosopher Spinoza precisely described the premise of counterconditioning in his *Ethics*: "An emotion can only be controlled or destroyed by another emotion contrary thereto, and with more power for controlling emotion." Similarly, William James emphasized the necessity of employing an emotional impulse to control the expression and magnitude of an opposing emotional impulse: "Reason, per se, can inhibit no im-

pulse; the only thing that can neutralize an impulse is an impulse the other way" (1890/1950:393). This is an important basic principle and credo for dog trainers and behaviorists to keep foremost in mind when working with highly motivated behavior. Of course, James and Spinoza had humans in mind, but the same sort of behavioral flexibility exists in dogs.

Counterconditioning essentially involves opposing one response by the elicitation of another. To eliminate an unwanted CR, the CS controlling the response is paired with an US that elicits a contrary response. If the UR is sufficiently strong and incompatible with the undesired CR, the new connection between the CS and US will attenuate or block the unwanted response in the future. Counterconditioning is a powerful tool. Even very painful unconditioned stimuli can be counterconditioned by pairing them through gradual increments of intensity with a strong contrary US. Pavlov, for example, counterconditioned traumatic shock by pairing its presentation with food. A dog was shocked and then given a piece of food, and forced to eat it if he refused to take it voluntarily. Over the course of several sessions, the intensity of stimulation was gradually increased until the shock was so severe that it caused "severe burning." Even when stimulated with the maximum current, the dog showed no signs of fear but only turned his head toward the customary location of food, followed by profuse salivation, and chomping appetitive movements in anticipation of food.

In addition to appetitive counterconditioning, aversive counterconditioning is commonly used in dog training. For example, a dog may develop an interest or appetite that is dangerous or unacceptable for one reason or another. Such appetites can be very persistent and resist ordinary methods of deterrence. Just as counterconditioning can be used to reduce aversive associations and avoidance, it can also be used to generate or increase aversive associations and avoidance when necessary. Appetitive interest and attraction to a forbidden or dangerous item can be effectively decreased by pairing the item with a sufficiently aversive or startling stimulus. During aversive counterconditioning, the US (startle) must closely follow the presentation of the CS (forbidden item) or US evoking undesirable interest. Many applications and a variety of conditioning arrangements in puppy and dog training use aversive counterconditioning. Aversive training procedures should always be avoided until less intrusive methods have been considered and implemented.

CLASSICAL CONDITIONING AND FEAR

Voluntary Versus Involuntary Behavior

Behavior can be roughly divided into two broad categories: *voluntary* (goal directed) and *involuntary* (reflexive). This division is not arbitrary but is based on the two fundamental ways behavior is modified. Voluntary behavior is highly goal directed and influenced by the consequences it produces. Involuntary behavior, on the other hand, is largely composed of automatic mechanisms operating outside of a dog's volition and ability to choose. In the case of involuntary behavior, the presentation of a sufficiently salient stimulus evokes the elicitation of a highly predictable response. Involuntary behavior is usually associated with simple reflexive and emotional responses. Although functionally independent of voluntary control, involuntary behavior is affected by antagonistic motivational states and modified through associative learning procedures. Together voluntary behavior and involuntary behavior provide an adaptive interface between a dog's changing biobehavioral needs and the surrounding environment.

Behavioral disorders are complex and problematical, consisting of both instrumental and reflexive (respondent) components. Defensive behavior involves two motivational processes, one under relatively more voluntary control (freeze, flight, and fight) and the other under relatively more involuntary or autonomic control (fear and anger). For example, individuals fearful of snakes cannot by an act of will persuade themselves not to feel afraid when confronted with a snake, but can, despite great apprehension and reluc-

tance, possess enough self-control not to run away. Consequently, to attenuate fearful behavior properly, one must address both instrumental fearful responses as well as the underlying emotional concomitants. From the perspective of some forms of behavior therapy, fear is best reduced by simply strengthening instrumental behavior incompatible with fear while ignoring or blocking (response prevention) fearful behavior when it happens to occur. Sometimes, however, the underlying fear is so strong and pervasive that it must first be addressed and modified through direct means, including respondent counterconditioning, relaxation training, exercise, or medications. As the underlying fearful arousal is diminished, the instrumental behavioral expressions of it will spontaneously improve, thus making it easier to shape more confident behavior.

Three Boys and a Brief History of Fear

Among the earliest controlled studies on the development of conditioned fear were those carried out by the American psychologist John Watson (1924/1970) and coworkers. Watson, often called the father of behaviorism, successfully conditioned a stable fear response in an 11-month-old orphan infant named Albert (Watson and Rayner, 1920). Albert was exposed to a white rat and observed for his reactions. Prior to conditioning, he was accustomed to holding and playing with the animal and exhibited no signs of fear. The fear-conditioning stimulus used by Watson was a startling sound made by striking a hammer against a heavy steel bar held behind the infant's head. As the child reached for the rat, the bar was struck, causing Albert to recoil from the animal. Over the course of several similar trials, Albert's fear deepened and became progressively more reactive and generalized. It was found during subsequent tests that Albert's fear had generalized to include other furred animals (a rabbit and a dog) and inanimate objects such as a fur coat. Although there were plans to "uncondition" Albert, he was subsequently adopted by a family living out of town. No one knows what finally became of Little Albert.

Additional work was carried out by Mary Cover Jones (1924) in an effort to isolate the most effective training techniques for reducing fearful behavior in children. Jones studied several methods, but the one she called *direct unconditioning* is of particular interest to dog trainers and behavior consultants. Peter, a 3-year-old boy, already exhibited intense fears toward various animals and furry objects. After trying several methods with varying degrees of success, the researchers exposed Peter to an early prototype of graded counterconditioning that turned out to be extremely effective. The method involved feeding Peter in the presence of the feared animal (a rabbit). The rabbit was initially caged and then systematically presented to the child at closer distances. The progress of these graded exposures was regulated by Peter's willingness to eat, based on an observation that relative appetite was a sensitive indicator of fear. The rabbit was gradually moved closer to the child through progressive steps, until finally he was able to eat without signs of anxiety while at the same time petting the animal who had been placed on his lap.

A decisive shift in the study of fear occurred with the publication of an article written by Wolpe and Rachman (1960). In the article, they criticize the psychoanalytical perspective on phobias and their development, especially with respect to Freud's interpretation of one of his cases involving a child named Little Hans. Little Hans, who was a patient of Freud, had acquired a strong phobia of horses. In a lengthy report, Freud concluded that the boy's fear was fueled by an underlying Oedipal conflict with his father. He argued that the horse was symbolically linked in the boy's mind with his father—the true object of the boy's fear. As the result of the child's forbidden wish to possess his mother sexually coupled with an unconscious desire to kill his father, the boy experienced a profound sense of guilt and transferred his fear of retribution to the horse. Wolpe and Rachman argued that little evidence in Freud's case study actually supported an Oedipal interpretation of the boy's fear. In reading the material, they discovered that the boy had witnessed a tumultuous accident in

which a horse had fallen in the street while pulling a bus. The experience was a traumatic one for Hans and, the researchers argued, one sufficient to explain the boy's subsequent fear of horses.

Phobic Cats and Systematic Desensitization

Wolpe's (1958) experimental work with conditioned fear was carried out with cats from 1947 to 1948. Several cats were exposed to conditioning procedures that resulted in neurotic fear reactions to a variety of stimuli and situations. One group was conditioned to respond to the "hoot" of a horn that was followed by shock delivered into the floor grid of the experimental cage. The second group of cats was first trained to go to a dispenser of food in response to a buzzer signal. Once this behavior was well established, shock was delivered just before the cat took the available food into its mouth. Both groups developed strong phobic reactions toward the conditioned stimuli. The latter method is very similar in effect to that used by Watson on Little Albert. Unlike Albert, however, who showed no signs of generalized fear involving the experimental setting, Wolpe's cats not only exhibited intense fear toward the eliciting conditioned stimuli, they also resisted entering the cage, exhibited various signs of fear while in the cage, and refused to eat even after several days of continuous food deprivation while in the cage where the shock too place.

Wolpe studied several methods for extinguishing fear in cats. Some of the fearful cats were encouraged to eat food by pushing it toward them with a stick. Wolpe theorized that the cats would see the hand as a conditioned appetitive stimulus, since they had been previously fed by hand. A few of the cats did, in fact, respond to this method. Cats who failed to respond to this first method were exposed to a directive training procedure in which they were forced into close contact with an appetizing food item. Under these conditions, several additional cats were eventually coaxed into eating. Since many of the cats not only exhibited fear in the experimental cage but also to the surrounding room, Wolpe attempted to feed the remaining cats in four separate rooms of increasing similarity to the one in which the shock took place. This method proved very effective, allowing the cats eventually to eat readily from within the experimental cage itself.

The next training problem was to devise procedures for reducing the cats' fearfulness and avoidance in the presence of the buzzer or horn sounds. This training goal was accomplished along two lines of conditioning. The first method was very similar to that used by Jones with the phobic child Peter. Wolpe determined that cats would remain relatively undisturbed if the hooter was sounded at a distance of at least 40 feet away. This distance could be progressively decreased by gradual successive approximations. This method was carried out until the cats accepted the sound of the horn and buzzer at full conditioning intensity. An alternative method he employed to attenuate the intensity of the eliciting CS was accomplished by truncating its duration to a fraction of a second. The first sample was presented at full volume for a fifth of a second. Under such conditions, the cats would initially react and, after a short delay (about 40 seconds), would consume the food pellet dropped into the cage. Gradually, over several trials, the delay between the CS sample and eating decreased until at last the cats were taking the food within a couple of seconds following the CS. The duration of the fear-eliciting CS was then gradually increased until the cats would continue eating under a continuous presentation of the CS for 30 seconds.

Reciprocal Inhibition

Wolpe attributed the effectiveness of his training efforts to *reciprocal inhibition.* Essentially, reciprocal inhibition postulates a hypothetical interference occurring when two opposing emotional states are simultaneously elicited. Two hedonically opposing emotional states cannot exist simultaneously: one overshadows or offsets the other. In the case of Wolpe's fearful cats, they could not be interested in food while at the same time feeling anxious; appetite in this case overshadows or reciprocally inhibits fear. This process of countering aversive emotional arousal by elic-

iting stronger appetitive arousal or relaxation in the presence of the aversive event is referred to as *counterconditioning*. Wolpe states the underlying principles facilitating the effects of counterconditioning as follows:

> If a response inhibitory of anxiety can be made to occur in the presence of anxiety-evoking stimuli it will weaken the bond between these stimuli and anxiety (1969:14).

Negative emotional reactions evoked by fear-eliciting conditioned stimuli can be systematically reduced, modified, or replaced with more adaptive and positive response patterns through counterconditioning. Many undesirable conditioned emotional reactions are traceable to some past event and are learned in a manner consistent with the experimental models devised by Watson and Wolpe. The goal of counterconditioning is to disassociate past learning from the eliciting CS and to establish new, more positive associations controlled by the same stimulus.

Graded Counterconditioning

Fearful emotional responses are subdued by the elicitation of competing incompatible emotional responses (e.g., appetite or relaxation). The central maxim informing this process is "contraries are cured by contraries," that is, two hedonically opposed emotional responses cannot exist at the same time—the elicitation of one reciprocally inhibits the other. For example, a strange noise occurring while a dog is happily chewing on a fresh bone is less likely to elicit fear than is a similar stimulus occurring at another time when the dog is not so preoccupied. In this case, the appetitive interest evoked by the bone reciprocally inhibits fear elicited by the strange noise. Other important factors affecting counterconditioning, as both Wolpe and Jones have demonstrated, is the intensity and proximity of the fear-eliciting CS. If the fear-eliciting CS is too strong or close, the incompatible counterconditioning stimulus may be overshadowed and the process impaired. For example, a xenophobic dog may not notice a stranger walking 100 feet away but will react with intense fear if the same person approaches too closely or attempts to make physical contact. For effective counterconditioning to occur, the dog must be gradually exposed to strangers at progressively closer distances and under increasing levels of provocativeness while the dog is concurrently stimulated by a strong counterconditioning stimulus.

The best counterconditioning results are achieved by presenting stimuli that either relax a dog or satisfy it appetitively while systematically exposing it to the fear-eliciting target. Relaxation and eating are incompatible with fear—that is, a dog cannot be simultaneously fearful while relaxing or eating. Some activities like playing, running, and even walking can be used as counterconditioning stimuli to reduce mild fears and anxieties. For convenience, food is usually chosen as the primary counterconditioning stimulus, although massage can be used effectively in some situations. The course of systematic desensitization follows a regular pattern. A hungry dog is progressively exposed to the feared object through a series of defined steps (a hierarchy of fear-eliciting stimuli), which enables closer proximity and, finally, direct contact without eliciting fear at any point. Each step of this hierarchy is associated with food and reassurance, providing a secure foundation for the next step. The dog learns to associate good things with the feared object, gradually abandoning its fearful attitude in exchange for a more positive expectation.

Conditioned fear is frequently very resistant to normal extinction procedures. Since fears and anxiety may not be attenuated under normal conditions, special methods must be employed to achieve the desired effect. In addition to counterconditioning, a key element in the reduction of anxiety and fear is controlled exposure that allows the dog to engage in direct interaction with the feared object/situation.

Interactive Exposure and Flooding

The reduction of fearful behavior is facilitated by utilizing a combination of behavioral training methods. In addition to graded counterconditioning, several other fear-reducing techniques have proven efficacious in reducing fear. Jersild and Holmes (1935) pro-

vide an important historical study detailing the broad aspects of graded *interactive exposure*—a method that has proven complementary to Wolpe's model and, according to some authorities, should replace it as the treatment strategy of first choice (Marks, 1977). Jersild and Holmes observed that two primary methods of confronting fear are most commonly used by parents of fearful children: direct repeated exposure to the feared object and ridicule. Of the two methods, direct exposure appears to be the most effective, resulting in the reduction of fear in 50% of the cases studied. Ridicule and invidious comments (e.g., wimp, "scar'ty cat") yield no benefit in bolstering a child's courage. They found that common childhood fears could be systematically reduced by replacing avoidant behavior with confidence-building interactive skills, resulting in the progressive development of *competence* in the fearful situation. Their method emphasizes developing various coping skills and participatory activities that the child engages in while in direct contact with the feared object/situation. They utilized attractive counterconditioning stimuli, not intended to change associative responses directly but to provide additional incentives to the child for making such contact. The counterconditioning stimulus serves as a bait to lure the child into sustained interactive contact with the feared object/situation. Similar benefits may be derived in the case of moderately fearful dogs. In many particulars, the Jersild and Holmes method anticipates current methods for reducing fear in dogs.

Since Wolpe's discovery, many studies have been carried out to evaluate the therapeutic efficacy of the desensitization and the counterconditioning process. The results have often been critical of Wolpe's conceptualization on several grounds. For instance, the need for a hierarchy of fear-evoking conditioned stimuli presented systematically in the presence of hedonically antagonistic counterconditioning stimuli (eating or relaxation) has proven relatively unimportant under experimentally controlled conditions (Delprato, 1973; Delprato and Jackson, 1973). In fact, according to Delprato's study (1973), simple extinction proved more effective than both systematic desensitization (graded counterconditioning) and graded exposure. Since the desensitization analogue used by Delprato differed from graded exposure only in terms of the presentation of food, it might even be further argued that the presentation of food actually interferes with the reduction of fear. One possible explanation he presented to explain this unexpected result is that the acquisition of food during graded exposure overshadows an animal's attention to the fear-eliciting stimulus. Unlike in the cases of graded exposure and simple extinction, the animal may have failed to learn that the CS no longer predicts a pending aversive event. Subsequently, when exposed to the fear-eliciting stimulus without food, the counterconditioned animal exhibited little or no improvement in comparison to controls.

The most important factor in the desensitization process appears to be sustained exposure to the fear-evoking stimulus until fear subsides (Marks, 1977). This procedure is commonly referred to as *flooding* through response prevention. Response prevention and direct exposure (flooding) can be carried out in the presence of full-intensity samples of the fear-eliciting stimulus or, more optimally, a progression of increasingly intense samples. A precaution needs to be carefully observed: if dogs are fearful when the flooding exposure is terminated, their fearfulness might be made worse. Also, there is some evidence that frequent brief exposures to the feared stimulus situation might actually strengthen the reaction rather than weaken it. Therefore, it is important that fearful exposures be of sufficient duration at each step to allow elicited fears to habituate before proceeding to the next step or before quitting.

Response Prevention and Directive Training

Whether counterconditioning or interactive exposure is used, additional supportive techniques may be required that force a dog into direct contact with the feared CS complex. At some point in the process, the dog may become overly reactive or attempt to escape from the situation. While care should be taken not to overwhelm fearful dogs with ex-

posures that they are unable to tolerate, when avoidance responding does appear it must be blocked or corrected (Askew, 1997). In some situations, dogs may completely refuse to engage in some behavior as the result of competing avoidance responding, such as climbing stair steps or entering certain rooms or places. In such cases, directive exposure involving the use of a series of corrective prompts on the leash is often both expedient and very effective.

Various response prevention techniques can be selectively applied during counterconditioning and flooding efforts. Occasionally, dogs undergoing rehabilitative training will persist in phobic avoidance behavior despite gradual and patient efforts. One theory suggests that avoidance responding actually forestalls the unlearning of fearful responses (Levis, 1979). Persistent avoidance responding prevents dogs from coming into direct contact with the fear-evoking stimulus, thereby impeding the normal extinction process. Experiments designed to block or prevent avoidance responding have shown that extinction of such behavior is facilitated by such measures (Baum, 1970). Response prevention involves physically restraining a dog so that the avoidance response cannot be performed, requiring instead that the dog directly experience the avoidance-signaling CS while being prompted to perform some incompatible response (e.g., sitting or lying down) that is consequently rewarded. Such training provides the dog with coping options that supersede the avoidance response and may eventually take its place. The foregoing discussion of fear and its management anticipates a more thorough treatment of the subject in Volume 2.

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7

Instrumental Learning

Now, whereas the gods have given to men the power of instructing one another in their duty by word of mouth, it is obvious that you can teach a horse nothing by word of mouth. If, however, you reward him when he behaves as you wish, and punish him when he is disobedient, he will best learn to do his duty. This rule can be stated in few words, but it applies to the whole art of horsemanship.

XENOPHON, *On the Art of Horsemanship* (1925/1984)

THE DISCUSSION in the preceding chapter was mainly limited to an exploration of the more or less involuntary mechanisms and processes mediating stimulus-response (S-R) learning. Behavioral change, however, often involves much more complicated and dynamic interactions between the animal and the environment than the S-R model can adequately handle. Opposed to the involuntary nature of reflexive behavior, a great deal of what a dog does is highly motivated, organized, and goal directed. These more complicated aspects of dog behavior cannot be reduced to a simple chain of S-R events.

DIFFERENCES BETWEEN CLASSICAL AND INSTRUMENTAL CONDITIONING

The dog's ability to learn as the result of experience is a key factor ensuring its adaptive success. In addition to the associative, information-producing functions provided by classical conditioning, dogs also depend on various instrumental or operant means to secure control over the social and physical environment. Through the combined efficacy of classical and instrumental learning processes, dogs can reliably predict and control the occurrence of biologically significant events. Classical conditioning provides dogs with predictive information about the occurrence of these events, while voluntary instrumental efforts serve to optimize the dog's control over them.

Instrumental learning differs from classical conditioning in several significant ways. An important distinction between these two forms of learning is embodied in the different uses of the terms *elicit* and *emit*. Reflexive or respondent behavior is *elicited* by an appropriate stimulus event, whereas instrumental or operant behavior is *emitted* without the presence or necessity of an eliciting stimulus. Another prominent difference between classical and instrumental learning is the relative amount of voluntary control exercised by an animal. In contrast to the largely involuntary nature of reflexive behavior, instrumental learning mostly involves goal-directed behavior that actively *operates* on the external environment to produce desirable consequences. Unlike reflexive behavior, instrumental behavior does not depend on an eliciting stimulus, although it can be brought under the control of a signal or discriminative stimulus.

As discussed previously, classical conditioning primarily involves conditioned and unconditioned stimuli and the various responses elicited by them. In the case of classical conditioning, response strength depends on various attributes belonging to the eliciting stimulus (e.g., its salience or intensity), the animal's readiness to respond, and the existence of a contingent relationship between the conditioned stimulus and the unconditioned stimulus. In the case of instrumental learning, response strength depends foremost on the presence of an established contingency between the response and a reinforcing outcome regularly following its occurrence. As is discussed later in this chapter, many other motivational, biological, and cognitive factors

affect the strength of instrumental behavior.

Classical and instrumental learning also differs in terms of their respective functions. A vital function served by classical conditioning is the formation of reliable predictive representations about the occurrence or nonoccurrence of beneficial or dangerous events. Instrumental learning, on the other hand, provides the animal with information about how these events can be successfully controlled through various behavioral adjustments involving approach, escape, or avoidance. As the result of such learning, the animal gradually maximizes access and control over attractive outcomes while avoiding or minimizing the occurrence of aversive ones. The information and behavior derived from instrumental learning is goal directed and biologically purposeful, forming a flexible repertoire of adaptive behaviors shaped for the preservation and protection of the animal. In combination, classical and instrumental learning activities provide a fluid and adaptive interface between the animal and the surrounding environment. Tarpy writes,

> Response learning represents a mechanism by which animals can change the world to their advantage. Since strong biologically active stimuli usually represent either valuable resources or threats to survival, then these stimuli must not only be predicted (stimulus learning provides one mechanism), but they also must be controlled. Organisms who have evolved the mechanisms that permit response learning can change the environment to their own advantage. They can acquire expectancies about future outcomes based upon their own behavior; and the response they execute alter stimuli in ways that are important for survival. (1982:94–95)

Instrumental-like Conditioning of Reflexive Behavior

Some evidence suggests that classical conditioning may not be the only way autonomic behavior is modified. Instrumental control of reflexive behavior appears to be possible under highly controlled experimental conditions. For example, Miller (1969) demonstrated that many reflexes can be modified with instrumental conditioning, utilizing a complicated operant conditioning procedure. In these experiments, rats were paralyzed with curare, and intracranial electrodes were placed into the brain to stimulate reward sites. Miller's preparation allowed the researchers to shape visceral activities, like heart rate, urinary output, peristaltic activity, and other autonomic functions, without the confounding influence of voluntary striated muscle activity. In one study, heart rate was differentially accelerated or decelerated depending on the presence or absence of reinforcement (intracranial stimulation). Heart-rate increases were also brought under the control of a compound (light and tone) discriminative stimulus (Miller and DiCara, 1967). Miller's work shows that under conditions of paralysis (i.e., when voluntary control of striatal muscle is disrupted) many autonomic functions can be altered by instrumental consequences (i.e., reward and punishment). In another study (Miller and Carmona, 1967), the salivary reflex in dogs was enhanced or diminished according to the consequences that followed its emission. Food naturally elicits salivation, but water does not. In their experiment, water was used as a reinforcer for salivation. In water-deprived dogs, salivation increased when it resulted in access to water and decreased when salivation postponed the delivery of water.

Additional evidence for the central control of autonomic functions comes from many biofeedback studies with humans. As a result of biofeedback, human subjects can learn to control such functions as heart rate and blood pressure voluntarily, though this is not necessarily evidence that an operant factor is at work. A subject may simply learn to selectively stimulate opposing motivational substrates through cortical enervations of the limbic system and other subcortical mechanisms.

A Uniprocess Theory of Learning

Classical and instrumental learning activities are always functionally integrated, although, for some practical and experimental purposes, they are frequently treated as separate phenomena. Over the years, several experimental psychologists have attempted to extend

Pavlov's findings to the study of instrumental behavior (Watson, 1924/1970; Guthrie, 1935/1960; Konorski, 1967; Gormezano and Tait, 1976). Pavlov himself believed that his reflexology would ultimately show that all learning was under the central control of a single S-R mechanism—an ambitious expectation that has fallen short of realization in many ways. However, recent and ongoing efforts by Robert Rescorla and his associates at the University of Pennsylvania to study instrumental behavior in terms of a Pavlovian analysis and methodology have yielded promising results. They have found Pavlovian associative linkages and structures embedded in every major facet of instrumental conditioning. These *encoded* Pavlovian structures include S-R relations, predictive stimulus-outcome relations, and Pavlovian-like response-outcome expectations (Rescorla, 1987, 1991).

THEORETICAL PERSPECTIVES

Attempting to understand how voluntary behavior is modified produces many interrelated theoretical and practical questions. Whereas behavioral scientists are primarily interested in developing general laws and principles governing learned behavior, trainers focus on how voluntary behavior is most efficiently modified and turned to practical purposes. Many lines of theoretical reasoning inform modern training theory. To appreciate these various contributions, a brief theoretical overview is provided below. This overview is not intended as a complete historical representation of the development of learning theory, but rather an effort is made to delineate some of the more significant historical issues and to summarize them with emphasis on their relevance for the dog behavior consultant and trainer.

THORNDIKE'S CONNECTIONISM

Edward L. Thorndike (1911/1965) is credited with founding the study of instrumental learning and placing comparative psychology on an experimental foundation. He was specifically interested in the question of how performance improved through trial and error, and he performed numerous experiments involving problem solving in cats and other animals.

Basic Mechanisms of Behavioral Change: Stamping In and Stamping Out

In the typical experiment, a cat was confined inside a puzzle box equipped with various mechanisms that could be manipulated to gain escape. A piece of fish was placed just outside of the cage as an added incentive. Thorndike measured the amount of time it took for each cat to find a way out, for example, by pulling on a loop of string or stepping on a platform arranged to release the door. Typically, cats engaged in a great deal of anxious searching behavior until they happened upon the correct solution by chance. Over the course of succeeding trials, the cats *gradually* became more skilled at escape. Thorndike observed that cats did not learn through insight or discovery but struggled through a process of trial and error with successful behaviors being *stamped in*, whereas frustrating, unsuccessful behaviors were *stamped out.* He concluded that a response was directly connected or bonded to the associated stimulus complex through a process of stamping in. According to Thorndike, all "learning is connecting." The animal's trial-and-error learning is dependent neither on deliberate reasoning nor on the exercise of some specialized instinct but depends entirely on the selective stamping in or stamping out of relevant S-R connections.

Thorndike's Basic Laws

Thorndike sums up his experimental findings in three basic laws of learning:

1. The *law of effect* states that an S-R connection (or bond) is strengthened or weakened depending on the hedonic quality of consequences following it. A response followed by a reward or "satisfier" strengthens the S-R bond and is stamped in. A response followed by a punisher or "annoyer" is weakened and is stamped out.
2. The of *law of exercise* states that a response is strengthened through use and weakened through disuse.
3. The *law of readiness* is couched in a pe-

culiar language of conduction units. Hilgard and Bower (1975) suggest that what Thorndike means by such units is an objective *action tendency* or preparation for action. When an animal is motivationally prepared to act, then the performance of the action is satisfying. When an animal is ready to act but prevented from doing so, the animal is annoyed, i.e., mildly punished or frustrated. Annoyance is also experienced (expressed as resistance) when an animal is motivationally unprepared to act but compelled to do so anyway. Readiness to act is affected by an animal's mental set or attitude (i.e., personal motivations determining what will annoy or satisfy it at any given moment). The law of readiness anticipates in several details Premack's theory of reinforcer reversibility (Premack, 1962). What under one set of motivational conditions is reinforcing may be punitive under another. For example, a satiated dog may find the opportunity to go for a walk more satisfying than the chance to eat more food. Additional eating for a satiated dog is punitive, i.e., annoying. On the other hand, a well-exercised dog would more likely choose to eat than undergo additional exercise. Whether a particular activity is annoying or satisfying is relative to the animal's varying motivational state.

Thorndike's law of effect underwent significant modification in his later writings. As the result of studies involving the use of mild punishment such as the word *wrong* or brief isolation, he generalized (wrongly) that punishment did not weaken instrumental behavior as he had previously postulated in the second half of the law of effect (see Chapter 9). Although he still recognized the power of punishment to disrupt behavior, he no longer believed that it was sufficient to alter learned connections to the same extent that rewards do. He also revised the law of exercise. He now argued that learning was not substantially influenced by the mere effort of practice and repetition, although such practice may benefit the performance of an already learned connection. For practice to be effective (i.e., promote additional learning), the repeated behavior must be associated with reinforcement—rote practice will not alter learned connections by itself.

Thorndike's emphasis on reward over punishment was an important contribution in the development of modern educational philosophy. Although subsequently proven wrong by a variety of studies, the rejection of punishment and the endorsement of more positive methods for behavioral control had a widespread and beneficial effect on animal training, child-rearing practices, and educational programs.

Guthrie's Learning Theory and Behavior Modification

The writings of Edwin R. Guthrie (1935/1960) are distinguished among the literary efforts of the major learning theorists by the simple and accessible language used to describe complex behavioral processes. Guthrie presents his theories and supporting information in a minimally technical form and effectively illustrates his theoretical arguments with numerous anecdotes and stories, including many involving dog behavior and training. Most of the concepts and principles discussed in his book *The Psychology of Learning* are easily within reach of patient, nonacademic readers. Although theoretically oriented, the book is organized more like a manual of behavior modification than a theoretical treatise. It is filled with valuable insights for the everyday control of behavior, representing an important source of practical information for the professional trainer/behaviorist working with problem dogs.

Like Pavlov and Watson before him, Guthrie argued that all learning (classical and instrumental) takes place within the context of a simple S-R model of associative conditioning. It is not surprising, therefore, to discover that his theory of learning is based on a single, all-encompassing postulate: "A combination of stimuli which has accompanied a movement will on its recurrence tend to be followed by the movement" (1935/1960:23). In other words, behavior occurring in some given situation will tend to recur under the same or similar circumstances in the future. In place of Thorndike's conceptualization of reward and punishment (involving satisfying and annoying events) and B. F. Skinner's notion of operant reinforcement, Guthrie proposed a unique interpretation of reinforcing

and aversive contingencies, arguing that either sort of event is sufficient to reinforce or suppress behavior, depending on the situation in which it happens to occur:

> I do not hold that all satisfiers tend to fix the associative connection that has just preceded them. When a satisfying situation involves breaking up the action in progress it will destroy connections as readily as punishment. In teaching a dog to sit up, tossing his rewarding morsel to a distant part of the room will prove a very ineffective method. There is no doubt of the satisfying character of the meat. The dog certainly "does nothing to avoid, often doing such things as attain and preserve," not, of course, the meat, but the eating of it. But the effect of the reward will be that the dog instead of sitting up stands ready for another dash across the room. ... Just as satisfiers do not always "stamp in" a connection, so annoyers do not, as Thorndike himself perceived, always "stamp out." What we can predict is that the influence of the stimuli acting at the time of either satisfaction or annoyance will be to reestablish whatever behavior was in evidence at the time. (1935/1960:127)

The hedonic value (i.e., relative pleasure/pain) of the reinforcing event is not intrinsically significant to the effect it has on behavior, although the emotional excitement generated by the event (punitive or rewarding) facilitates its reinforcing effect, i.e., excitement accelerates learning. In general, the event's significance is determined by what it *does* to behavior. Both rewards and punishers serve to interrupt ongoing behavior, thereby preventing subsequent behavior from interfering with the situation and competing with the emission of the target behavior. For example, throwing food on the floor just as surely suppresses jumping up as shoving the dog off does. At the moment of reinforcement, both procedures result in the dog having returned all four feet on the ground. According to Guthrie, the feeling states generated by such events are irrelevant to what is learned, what is relevant is what the animal does:

> It is not the feeling caused by punishment, but the specific action cause by punishment that determines what will be learned. In training a dog to jump through a hoop, the effectiveness of punishment depends on where it is applied, front or rear. It is what the punishment makes the dog do that counts, or what it makes a man do, not what it makes him feel. The mistaken notion that it is the feeling that determines learning derives from the fact that often we do not care what is done as a result of punishment, just as long as what is done breaks up or inhibits the unwanted habit.
> (1935/1960:132)

Within the context of Guthrie's system, the adaptive function of learning is the formation of stereotyped and effortless habits. According to this view, such stereotyped habits serve the organism by refining and making more efficient its adaptation to the surrounding environment. Once established, stereotypic habits tend to persist and may resist being "broken" or "sidetracked" through training. One method described by Guthrie for breaking a habit involves isolating the initiating cues and associating them with other behaviors that are incompatible with the unwanted one—a process known to the contemporary behavior therapist as counterconditioning. This is not always an easy process, since many initiating cues may support a well-established habit. Although aversive punishment is a useful procedure, unless it is applied in a sufficiently intense form, it may not prove to be very effective but could instead inadvertently reinforce the unwanted habit by making its performance more exciting. Many negative attention-seeking behaviors are maintained under the control of such inadequate punitive contingencies. Further, although punishment can be an effective means for breaking unwanted habits, such treatment may, in addition, produce adverse side effects, like making the punishing agent (e.g., the trainer or owner) a cue for fearful behavior and avoidance. Guthrie points out that aversive punishment is not always necessary and notes that any external "interference that captures attention and introduces a new activity will be successful" (1935/1960:118). Again, punishment does not depend on how it makes the animal feel but on what it makes the animal do. To be effective, the distracting activity must be physically opposed to and

incompatible with the unwanted behavior, so that "the muscle set of the obnoxious behavior which is the cause of its persistence is thoroughly changed" (1935/1960:118).

Counterconditioning or *response substitution* is an important procedure in Guthrie's system of behavior modification. In the process of illustrating this method, he tells the story of a horse that had been the subject of some mischievous training by two farm boys. The boys arranged themselves so that while one of them commanded the horse "Whoa," the other poked the poor animal with a pitchfork. The hoped-for result of their experiment was quickly obtained. When the hapless owner (a pastor visiting the boys' family) took his horse back from their care, he discovered to his discomfiture and terror what the boys had done in his absence. Upon issuing the command "Whoa," his erstwhile dependable and docile horse reared up and charged wildly out of control. Guthrie suggests that this incident dramatically exemplifies the process of response substitution in which a previously conditioned stimulus is associatively linked with a new and incompatible response:

> How do stimuli become distracters or inhibiters of an action? We may recall that in the case of the pastor's horse the sound of the word "Whoa" had previously been a signal for stopping. This had been in turn the effect of training in which the horse had been checked by the rein and the sound uttered a second or so before. The boys' efforts had substituted another reaction for the conventional one and in effecting this substitution the word became an inhibiter of the first response. ... A stimulus may thus be unconditioned by the very simple means of becoming a conditioner for an incompatible movement. Unlearning becomes merely a case of learning something else. And the rule which states whether conditioning or unconditioning will occur becomes simply the familiar principle of conditioning: Stimuli which are acting at the time of a response become conditioners of the response. In this case, *the response referred to in the rule is a response incompatible with the former response.* The horse can not lunge forward and stop at the same time. This is physically and neurologically impossible. The signal inhibits stopping because it has become alienated from that response by a later association with the incompatible response. (1935/1960:55–56)

Guthrie also describes several other general and now familiar methods for breaking habits. Besides arranging for the evocation of incompatible substitute behavior in the presence of cues controlling the performance of an unwanted habit, habits can be systematically reduced or eliminated by gradual exposure. Guthrie refers to this general method as *negative adaptation*. In this procedure, a stimulus is presented at an intensity or form that remains just above threshold tolerances and is then gradually altered in intensity until the previously intolerable stimulus is readily accepted at full strength. Many fears and aversions are reduced through negative adaptation. Negative adaptation is particularly effective in cases where gradual exposure to the negative stimulus occurs in the presence of a more positive stimulus, like attention, food, or relaxation. This general method is referred to in the contemporary language of behavior modification as *systematic desensitization*. Guthrie illustrates the procedure of negative adaptation by recounting various techniques used by animal trainers to reduce fearful reactions in dogs and horses. For example, he describes the case of hunting dogs that are gradually exposed to increasingly loud and naturalistic gunshot reports until the dogs can react impassively to a shotgun blast at close quarters (Whitford, 1928). Similarly, a horse being trained to carry a rider is first exposed to the saddle and other gear gradually and systematically (e.g., starting with a light blanket and progressively adding more equipment and weight) until the horse can tolerate the full weight of the rider on its back. In addition to gradual exposure, Guthrie also favors the use of what is generally referred to today as *response prevention*. He writes in this regard that "when the cue occurs but the response *is prevented by any means,* negative adaptation of the response to that cue takes place" (1935/1960:63). Guthrie succinctly summarizes these basic methods for the breaking of unwanted habits:

> Bad habits are broken by substituting them for good habits or innocuous habits. The rule for breaking an undesired conditioned response becomes this: So control the situation that the undesired response is absent and the cue which has been responsible for it is present. This can be accomplished by fatiguing the response, or by keeping the intensity of the cue below the threshold, or by stimulating behavior that inhibits the undesired response. If the cue or signal is present and other behavior prevails, the cue loses its attachment to the obnoxious response and becomes an actual conditioner of the inhibiting action. (1935/1960:65)

Another behavioral method discussed by Guthrie at some length involves *response fatigue* or *negative practice*. In the case of negative practice, the animal is required to repeat the offending behavior over and over again in the presence of the controlling cues. Guthrie describes the case of a little girl who had adopted the habit of playing with matches. As punishment failed to suppress the habit, the child's worried mother resorted to negative practice in an effort to break the habit. The procedure was simple: she simply required that her daughter strike dozens of matches in quick succession. The child soon bored of the activity and began actively to resist her mother's prodding. Instead of lighting matches, she began to push them away. As a result, a new set of responses incompatible with lighting matches was evoked in the presence of cues that were previously associated with lighting them. The last thing the child did in the presence of the matches was to push them away. Later, when the child was exposed to matches again, she showed no interest in playing with them. Theoretically, the escape or refusal response produced by negative practice became prepotent over "match lighting," thus causing the girl to abandon the dangerous habit. Such negative practice procedures can be effectively employed in the case of many intrinsically reinforced activities exhibited by dogs. An area of concern about negative practice is how it might impact on desirable behavior. For example, if one forces dogs to retrieve until they quit, their willingness to retrieve in the future will probably be negatively affected by the experience. Similarly, excessively long and repetitive training sessions may not be as conducive to learning as shorter and more varied ones.

It is not within the scope of this discussion to cover in detail all of the major contributions of Guthrie to the current trends and methods informing behavior therapy and behavior modification, but it should be noted, as is rarely done in the pertinent literature, that most of these developments owe Guthrie a great deal (Malone, 1978). Many of the major contemporary therapeutic procedures, including in vivo exposure and response prevention, counterconditioning, systematic desensitization, negative practice, and overcorrection, are described in detail by this insightful psychologist.

TOLMAN'S EXPECTANCY THEORY

Edward C. Tolman (1934) adhered to many of the fundamental tenets of behaviorism but also introduced several new perspectives into the study of behavior and learning—some of which were highly controversial and inconsistent with the behaviorist platform. Tolman viewed the study of behavior both as an experimental process (fact finding, hypothesizing, and falsifying) but also emphasized an interpretative component that evaluated the meaning or purposiveness of the behavior being studied. Most behaviorists before him viewed behavior as a *molecular* phenomenon composed of individual S-R effects and relationships. Tolman believed that behavior had to be investigated in the context of the subject's intended purpose, thus extending the study of behavior to include an evaluation of its purpose, that is, its *molar* implications.

Tolman's scientific thrust aimed at developing hypothetical constructs inferred from concrete experimental observations of behavior. The study of purposiveness does not imply observations based on empathy or introspection (methods that Tolman rejected) but rather the formulation of inferences derived from observed behavior. In the scientific study of behavior, three experimental variables co-interact to arrive at significance:

1. *Independent variables*: The various controlled aspects of the experiment, especially the stimulus conditions and motivational state of the animal.
2. *Dependent variables*: All measured changes occurring in the behavior of the subject under the influence of controlled experimental conditions.
3. *Intervening variables*: Abstract constructs necessary to explain the observed S-R relationship.

The intervening variable is not a subjective interpretation but an objectively defined presumption arrived at by holding constant all independent variables except those hypothesized significant to it. The intervening variable is inferred from experimental evidence—that is, it helps make sense of experimental results. The validity and usefulness of the intervening variable is established by making predictions based on it and then designing experiments to systematically falsify those predictions. The intervening variable is operationally defined and delimited by the results of such experimental analysis and falsification.

For example, if a dog is presented with two bowls of food, one with meat in it and the other with dry food, the dog will most likely choose the one containing meat. A reasonable conclusion that one might draw from this experiment is that the dog "prefers" meat over dry food. Although this is a possible conclusion, however, it is not the only one possible from this experiment. To demonstrate preference some quantifiable correlation needs to be elaborated, defining *preference* (itself unquantifiable) as the most relevant variable controlling the dog's choice of meat over dry food. A hypothetical experiment might involve making the dog expend physical energy (jumping over a barrier of increasing difficulty) or mental effort (solving a difficult puzzle or maze) to acquire the meat as a goal and then comparing the dog's effort with respect to other food items. The assumption here is that the dog's preference for the food item is positively correlated with a willingness to work harder for it. Furthermore, his preference can be quantified relative to other less preferred items of food.

A slightly more complicated situation occurs in a two-choice discrimination task. In this experiment, the dog is trained to choose between two cards, one patterned with a checkerboard pattern and the other left blank. Choosing the checkerboard pattern always results in the presentation of food, whereas the blank card is never reinforced. Within several trials, the dog learns to choose the patterned card when prompted to choose. In this case, many possible intervening variables may subsist between the presentation of the positive and negative cards and the pattern of subsequent choice making. One very general hypothetical construct is that the dog "thinks" about the choice options and then chooses according to cognitive rules of discrimination; another broad view might theorize that the dog "learns" to choose the correct card as the result of trial and error; another observer might claim that the dog is innately attracted to patterned objects and is more likely to attend to the checkerboard-pattern card over the blank card; another possible theory is that the positive choice is an outcome of the nonreinforcement of the blank card (extinction) rather than a result of reinforcement of the positive card; and another theorist might explain the dog's mastery as an outcome of classical conditioning—that is, the dog is attracted through associative learning to the positive card.

As the foregoing inventory of possible intervening variables shows, there are many possible ways to explain the dog's successful discrimination. To determine how the dog manages to learn such a discrimination task requires experiments that isolate one intervening variable at a time while controlling the effects of others. The theory that the dog is innately attracted to the positive card can be easily *falsified* by presenting the blank card as the positive stimulus and comparing relative rates of learning with the checkered card. But what about the relative importance of trial and error versus extinction-based learning, and the role of classical conditioning? What are the most important variables influ-

encing discrimination learning? Answering such questions as these would require the design of several controlled experiments isolating significant from confounding variables.

Tolman placed a stronger emphasis on stimulus or sign learning than he did on response habit formation (i.e., Thorndike's stamping-in or stamping-out process). Instead of learning a response pattern, Tolman argued that an animal learns a cognitive map of significant relations or sign-gestalts (signs, significates, and behavior routes leading from sign to significate) in the environment, leading to the satisfaction of appetitive demands and goals. In a general sense, *signs* correspond to the classical conception of the conditioned stimulus and *significates* to the unconditioned stimulus:

> The sign-gestalt theory asserts that the conditioning of a reflex is the formation of a new sign-gestalt. It asserts that a conditioned reflex, when learned, is an acquired expectation-set on the part of the animal that the feature of the field corresponding to the conditioned stimulus will lead, *if the animal but waits* [behavior route], to the feature of the field corresponding to the unconditioned stimulus. (Tolman, 1934:393)

Hilgard and Bower (1975) described several experiments that tend to support Tolman's cognitive interpretation of learning. One of these experiments (Tinklepaugh, 1928) involved a delayed-response test in which a hungry monkey was shown a banana that was then hidden under one of two cans. The monkey quickly mastered this discrimination and easily found the concealed banana. Later, while the monkey was out of sight, the banana was secretly removed and replaced with a leaf of lettuce. When the monkey returned and discovered the change, he rejected the lettuce (a less preferred food item) and began searching for the hidden banana. This study implies that the animal had formed a definite expectation about finding a banana. Besides forming expectations about outcomes, animals learn from signs and place cues how to reach specific goals—that is, the animal is not learning a specific series of responses but exhibits behavior that implies that he *knows* where the goal is located and uses various signs and routes to get there, which is a "what leads to what" theory of learning. Another study [Macfarlane (1930), reported by Hilgard and Bower (1975)] provided additional support for a connection between cognitive mapping and goal-directed behavior. Macfarlane first trained rats to wade through a flooded maze and then required that they swim the course instead. The swimmers were found to do equally well as the waders, indicating that the response sequence was not dependent on learning a set of specific motoric or kinetic actions but depended on a more general knowledge of place.

Thorndike (1946) proposed an experiment to test the role of learned expectancy versus habit formation and response reinforcement in instrumental learning. The experiment involved placing a rat on a cart and pulling it through a maze. After a number of such trials, the rat would than be tested for its ability to learn the maze route and the results compared with that of a naive rat not previously exposed. Thorndike predicted that both subjects would learn the task equally well. However, subsequent studies have contradicted Thorndike's prediction (Mazur, 1986). Experiments by Dodwell and Bessant (1960) found that such preexposure *did* affect learning rates in a positive direction. In their experiment, animals were pulled through a water maze in a little car. Subsequent tests demonstrated that the preexposed rats performed better than controls not exposed. Earlier studies demonstrated that rats that underwent pretraining exposure, by being permitted to explore the maze prior to training, did substantially better than controls not given such exposure. This latter evidence is somewhat confounded, however, since the benefit of such pretraining exposure may have been due to adaptation to the training environment rather than due to learning. On the whole, these results contradict Thorndike's view that instrumental learning is solely dependent on response-contingent connections.

Tolman's learning theory makes several theoretical distinctions between learning and performance. For Tolman, learning is independent of performance, but performance is

not independent of learning. Motivational levels strongly impact performance by generating goal-directed tensions demanding satisfaction. In an important sense, performance is a composite of current motivational states and past learning experiences. Even though learning is not dependent on motivation, as seen in the aforementioned case of latent learning, it is not entirely independent of it either. Motivational substrates (appetite, fear, and aversion) define the specific details of the environment that an animal most alertly and selectively attends to. An animal pays greatest attention to and learns the most from items that possess significant motivational interest. Hungry dogs seek out signs of food, whereas fearful dogs search for routes of escape. The cumulative organization of all available signs and routes together with their corresponding significates forms a cognitive map of sign-gestalts representing the overall field of available expectancies (Tolman, 1948).

Perhaps Tolman's most significant contribution to the study of animal behavior is his emphasis on the cognitive aspects of learning. From this perspective, learning represents much more than the acquisition of a series of simple S-R outcomes or response-reward relationships. Tolman's view places learning within a much broader context or field. Learning takes place on an integrative, molar level where S-R events are interpreted and made meaningful by assimilation of the particular into the general, a mediation effected by "sign-gestalt expectations." Through learning, dogs are ever-forming predictive interpretations and expectancies about the occurrence of important stimulus events—a process that is both purposive and cognitive.

B. F. Skinner and the Analysis of Behavior

Undoubtedly, the most forceful and controversial figure in the history of behaviorism is B. F. Skinner (1938/1966). Many of the concepts and principles used by the professional trainer/behaviorist were originally developed in the laboratory of Skinner and subsequently elaborated by his many devoted followers, who refer to themselves as *behavior analysts*. Skinner's system is coherent and eminently pragmatic, with direct and powerful applications for the modification of behavior in the practical setting. Like Thorndike before him, Skinner viewed the effects of reward and punishment asymmetrically, placing far greater emphasis on the use of positive consequences, rather than punishment, for altering and controlling behavior. Skinner derived his emphasis on behavioral consequences directly from the tradition of Thorndike and the law of effect. A publication of particular interest to trainers interested in becoming better acquainted with his system and terminology is the programmed text *The Analysis of Behavior* (Holland and Skinner, 1961), which is a well-designed presentation of the basic concepts of behavioral analysis provided in a user-friendly format. Another well-written and easily understood introduction is *A Primer of Operant Conditioning* (Reynolds, 1968). For a more thorough and detailed treatment of behavior analysis, the books *Learning* (Catania, 1992) and *Psychology of Learning and Behavior* (Schwartz, 1989) are highly recommended.

One of the most important experimental contributions made by Skinner to the study of behavior was the invention of special equipment for recording behavioral events. The *Skinner box* is composed of a bar lever (for rats) or a disc (for pigeons), a food magazine, and a light and sound source for the presentation of discriminative stimuli. The animals are trained to operate the manipulanda by either pressing the lever or pecking (in the case of pigeons) an illuminated disc. These responses are then recorded on a cumulative recorder that graphically displays the animal's rate of responding (number of responses per unit of time) on a rolling sheet of paper. Through the use of a cumulative recorder, the experimenter can track changes in the rate of behavior as it is related to various reinforcement schedules and the alteration of other significant independent variables. In the modern learning laboratory, these scheduling and recording functions are usually managed through computer automation. Skinner was primarily concerned with measuring changes in emitted behavior under the influence of varying conditions of reinforcement. The manipulation and analysis of

reinforcement schedules remains Skinner's most important contribution to learning theory.

Skinner's system of operant and respondent conditioning consists of two sets of binary laws. The Type S laws that regulate respondent learning are inductive generalities derived from the studies of Pavlov:

1. *The law of conditioning of Type S:* "The approximately simultaneous presentation of two stimuli, one of which (the 'reinforcing' stimulus) belongs to a reflex existing at the moment at some strength, may produce an increase in the strength of a third reflex composed of the response of *the reinforcing reflex and the other stimulus."*
2. *The law of extinction of Type S:* "If the reflex strengthened through conditioning of Type S is elicited without presentation of the reinforcing stimulus, its strength decreases" (1938/1966:18–19).

The Type R laws governing operant learning are very reminiscent of Thorndike's modified law of effect:

1. *The law of conditioning of Type R:* "If the occurrence of an operant is followed by presentation of a reinforcing stimulus, the strength is increased."
2. *The law of extinction of Type R:* "If the occurrence of an operant already strengthened through conditioning is not followed by the reinforcing stimulus, the strength is decreased" (1938/1966:21–22).

These are the basic laws of Skinner's system of learning. In many ways, they are little more than a reiteration of Pavlov and Thorndike. Skinner's contribution does not rest on the discovery of the general laws of learning but on the creative and productive ways that he applied them to the study of behavior.

Skinner refers to operant conditioning as Type R learning, emphasizing its independence from stimulus learning or Type S learning. In Type S learning, the stimulus *elicits* a response in the manner of Pavlov. In Type R learning, the animal *emits* a response in an effort to operate on the environment to produce desirable consequences. He denies that operant conditioning is an S-R system, claiming that the "stimulus occupied no special place among the independent variables" of his studies. Although stimuli play no part in the sense of response elicitors in operant conditioning, they do play important subsidiary roles in announcing conditions of reinforcement (discriminative stimuli)—that is, they inform an animal when reinforcement is available given that a particular response is emitted. Another stimulus used in operant conditioning is the conditioned reinforcer. When a desired behavior is emitted, the response is bridged to the unconditioned reinforcer by the presentation of a conditioned reinforcer. A conditioned reinforcer is a neutral stimulus that has been associatively linked with an unconditioned reinforcer (operant reinforcer) through respondent (classical) conditioning.

One of Skinner's most controversial positions was his rejection of most forms of scientific theorizing. For example, he consistently argued against extrapolating from behavioral observations and data back to some more original place in the brain or mind of the animal. He eschewed all theorizing that went beyond empirically founded predictions or guesses in anticipation of experimental results. In a seminal article, "Are Theories of Learning Necessary," Skinner (1950) outlined his experimental approach to learning. According to Skinner, the study of behavior should be strictly limited to observable behavioral events that are precisely described in objective behavioral terms only. He strongly rejected the hypothetico-deductive method in which hypotheses are formulated and tested as being wasteful and productive of much useless experimentation. In addition, he excluded physiological descriptions and theories as well as mentalistic and hedonic interpretations like expectancies and pleasures occurring inside of the subject. Finally, he rejected conceptual accounts that, although relying on operational constructs referring to observed behavior, make appeal to explanatory extrapolations and intervening variables not physically present in the observed event:

> A science of behavior must eventually deal with behavior in its relation to certain manipulable variables. Theories—whether neural, mental, or conceptual—talk about intervening steps in these relationships. But instead of prompting us to search for and explore relevant variables, they frequently have quite the opposite effect. When we attribute behavior to a neural or mental event, real or conceptual, we are likely to forget that we still have the task of accounting for the neural or mental event. When we assert that an animal acts in a given way because it expects to receive food, then what began as the task of accounting for learned behavior becomes the task of accounting for expectancy. The problem is at least equally complex and probably more difficult. We are likely to close our eyes to it and to use the theory to give us answers in place of the answers we might find through further study. (1950:194)

Skinner also denies the usefulness of intervening variables (à la, Tolman):

> The simplest contingencies involve at least three terms—stimulus, response, and reinforcer—and at least one other variable (the deprivation associated with the reinforcer) is implied. This is very much more than input and output, and when all relevant variables are thus taken into account, there is no need to appeal to an inner apparatus, whether mental, physiological, or conceptual. The contingencies are quite enough to account for attending, remembering, learning, forgetting, generalizing, abstracting, and many other so-called cognitive processes. (1938/1966:xii)

While the foregoing is ostensibly a logical argument against certain forms of theorizing, it falls short as a general methodological principle for the study of behavior. In spite of Skinner's objections against the study of mediational events, behavior is a mediated event that depends on a variety of internal cognitive and conative mechanisms for its purposeful expression. Furthermore, considering the many successes of other scientific disciplines employing the hypothetico-deductive method, it is hard to view Skinner's rejection of it very seriously. It is difficult to imagine where physics and chemistry would be today if physicists and chemists had depended on an experimental method in which hypothesis, deduction, and falsification were preemptively excluded from the process of research.

Skinner has been referred to as a *radical behaviorist*—a term applied with no lack of contempt by detractors, but a name proudly adopted by some ardent enthusiasts of his method and brand of behaviorism. Contrary to a popular misconception, Skinner did not deny the existence of private feelings or individual purpose and meaning in the lives of people and animals. He did, however, reject such private experience as adequate subject matter for direct scientific observation and study. According to his viewpoint, internal experiences are controlled and modified in the same way that overt behavior is: by external contingencies of differential reinforcement and the law of effect. Furthermore, since private experiences do not submit to direct objective measurement, material like personal feelings and purpose can only be studied in the context of actual behavioral events. In other words, feelings like anger and love can be formally studied only by investigating their behavioral manifestations, that is, actual displays of aggressive or affectionate behavior occurring under various controlled circumstances.

Basic Concepts and Principles of Instrumental Learning

Terms and Definitions

Instrumental learning is regulated by what Thorndike has called the *law of effect*, which states that instrumental behavior is differentially strengthened (reinforced) or weakened (punished) by the consequences produced by its emission. Among behaviorists, the term *reinforcement* is preferred over the word *reward* for describing events or outcomes that increase the frequency/probability of instrumental behavior. Two common concerns are often expressed in defense of this preference: (1) The word *reward* implies that the animal itself is compensated for the emission of the selected behavior; however, such compensation does not necessarily mean that the emitted response is strengthened as a result. (2) Opposed to the vague meaning of reward,

the term *reinforcer* is more precisely defined in terms of the measurable effect it has on behavior—that is, a behavior is reinforced when, other things being held equal, the future probability/frequency of the behavior it follows is increased by the presentation of the reinforcing event. A reward may or may not increase the future probability of the behavior it follows—if it does, it is a reinforcer.

The technical distinctions between reward and reinforcement are clear; however, the technical language becomes a bit more murky and forgiving when it comes to the term *punishment*. It is a little perplexing when one is admonished not to employ the word *reward* (because of the aforementioned reasons) but can, in the same breath, say correctly that a behavior is *punished*. There appears to be an obvious double standard at work in the way these two terms are scrutinized. Both words in common usage are typically directed toward the agent of behavior—not the behavior itself. The term *punishment*, therefore, appears to suffer the same sort of ambiguity as the word *reward*. In practice, this is not a very serious conceptual problem, since *punishment* is operationally defined as an event that lowers the probability of the behavior that it follows. Likewise, though, the word *reward*, given a similar operational definition, can be used as a synonym for *reinforcer*. For the sake of consistency, though, some other term would be preferable to the word *punishment*. It is unfortunate that we do not have a parallel word in English, like *suppressment*. For one thing the word *suppression* refers more explicitly to the effect that punishment has on behavior and, thereby, avoids the emotional connotations associated with this culturally loaded term. For future reference, the terms *reward* and *punishment* are used here in the more technical sense of events that differentially increase or decrease the future probability/frequency of the behavior they follow.

In general, there are two ways in which the probability/frequency of behavior is affected by the consequences it produces:

Reinforcement (R or S^R) increases the relative probability or frequency of the behavior it follows.

Punishment (P or S^P) decreases the relative probability or frequency of the behavior it follows.

In addition, there are two ways in which behavior is reinforced or strengthened:

1. *Positive reinforcement* (R+ or S^{R+}) occurs when a behavior is strengthened by producing or prolonging some desirable consequence.
2. *Negative reinforcement* (R– or S^{R-}) occurs when a behavior is strengthened by terminating, reducing, or avoiding some undesirable consequence.

Note: Both R+ and R– increase the future probability/frequency of the behavior they follow.

Finally, there are two ways in which behavior is punished or weakened:

1. *Negative punishment* (P– or S^{P-}) occurs when a behavior is weakened by omitting the presentation of the reinforcing consequence.
2. *Positive punishment* (P+ or S^{P+}) occurs when a behavior is *weakened* by presenting the previously escaped or avoided consequence.

Note: Both P– and P+ decrease the future probability/frequency of the behavior they follow.

In combination, these basic reinforcing and punishing contingencies provide four ways for modifying behavior, viz., R+/R– and P+/P– (Fig. 7.1).

Reinforcing Events

Dogs gain practical information about the physical and social environment through the consequences of their behavior. Such experiences teach them how to control and manipulate significant events vital to their interests. The exercise of control over important occurrences reinforces the learning process itself, both in terms of specific behavioral instances and in terms of general learning expectancies or sets. Learning is a cognitively organized pattern that must be mastered before com-

Frequency of Behavior			
Increase-reinforcement		Decrease-punishment	
R+	R-	P+	P-
Presentation of reward	Withdrawal or omission of aversive	Presentation of aversive	Withdrawal or omission of reward

FIG. 7.1. Various ways in which the frequency of behavior is influenced by the consequences it produces.

plex behavioral skills can be acquired. In an important sense, dogs are always learning *how* to learn.

Two complementary motivations drive instrumental learning: the maximization of positive outcomes and minimization of aversive ones. These complementary motivations correspond to the notions of positive and negative reinforcement. If a response becomes more probable as the result of its producing a desirable consequence (e.g., petting and food), then the potentiating effect is referred to as *positive reinforcement*. Conversely, if a response becomes more probable by its terminating or avoiding an aversive stimulus (e.g., leash correction), then the effect is referred to as *negative reinforcement*. Positive and negative reinforcement are the two primary ways in which goal-directed behavior is acquired and maintained.

Positive Reinforcement

Typical reinforcement events satisfy some physiological or psychological need. To hungry dogs, the opportunity to acquire a savory treat is worth effort and work. If the acquisition of food is made contingent on a dog sitting when requested to do so, the dog will quickly learn that sitting on cue results in the acquisition of the desired treat (positive reinforcer). After several such experiences, the probability that the dog will sit on cue is increased and will continue to increase as long as the performance is reinforced and the dog remains motivated or until additional learning is not possible (asymptote). In the foregoing case, the dog learns that a causal connection exists between the presence of a specific cue or discriminative stimulus (S^D), a response (R) and a resulting positive reinforcer (S^{R+}). Through this simple lesson, the dog not only learns how to sit, but, more importantly, the dog learns that its actions can control the environment—an outcome that makes learning itself intrinsically rewarding.

Negative Reinforcement

Negative reinforcement occurs when a dog discovers that a particular response terminates or avoids the presentation of an aversive stimulus. A natural example can be observed when a dog, having stayed too long in the sun, finds relief by moving to nearby shade. Moving out of the direct sunlight into the shade is a negatively reinforced behavior because it terminates the aversive condition of overheating. Traditional obedience training makes liberal use of negative reinforcement. For example, the sit exercise is often taught by applying an upward pull on the leash and

collar coupled with a downward pressure on the rump. The forces involved are mildly aversive. Under such stimulation, most dogs will at first struggle and attempt to resist the pressure, but after several trials they usually learn to escape it by following the applied forces in the correct direction and successfully learn to sit under compulsion. If a word cue ("Sit") is presented before the onset of the pressure, the dog will learn to avoid the negative event by sitting in response to the cue alone. After several such trials, the dog will begin to recognize a causal linkage between the presentation of the avoidance cue, specific and timely action, and the avoidance of the anticipated aversive outcome. Such learning depends on anticipatory signals that reliably predict response-produced outcomes. This pattern is confirmed (acquisition) or disconfirmed (extinction) by repeated experience.

Intrinsic Versus Extrinsic Reinforcement

There are two general sources from which positive and negative incentives are derived: *intrinsic* (part of the task itself) and *extrinsic* (external to the task). Intrinsic incentives are those attractive and aversive motivational inducements that belong to the task itself. Intrinsic positive reinforcers are inherent to behaviors (e.g., playing ball, chasing a cat, or jumping on guests) that are enjoyed in and of themselves and maintained without additional external reinforcement. Intrinsic negative reinforcers, on the other hand, are inherent to the relief provided by behaviors that avoid or terminate situations that are annoying in and of themselves (e.g., growling or snapping when threatened or escaping confinement when left alone). Extrinsic incentives include all positive and negative inducements that derive from sources other than the behavior itself (e.g., various attractive and aversive events). Intrinsically reinforced behavior is acquired and maintained under natural reinforcement contingencies, whereas extrinsic incentives are provided contingently by the trainer. Both intrinsic and extrinsic incentives play important roles in dog training and behavior modification.

Timing and Repetition

Understanding that behavior is modified by its consequences is an important insight into how dogs learn. In addition, timing and repetition also play crucial roles in the training process. For a reinforcer to be effective, it must closely follow the target behavior. Optimally, the reinforcer should be presented immediately after the target behavior is emitted. Further, the connection between the reinforcer and the target behavior is strengthened by frequent repetitions. With practice, dogs learn to expect the eventual presentation of the positive reinforcer as the result of emitting the selected behavior.

Differential Reinforcement

Behavior is a fluid phenomenon with each event flowing seamlessly into the next. Under natural conditions, no edges or boundaries sharply separate one behavior from another. Behavioral differentiation occurs as the result of selectively reinforcing responses and sequences of the dog's behavior that are compatible with the trainer's objectives and ignoring or punishing behavior that is not. This process of selection strengthens certain tendencies and patterns while extinguishing or suppressing other aspects of the dog's behavior. As a result of such pressure and change, the dog's behavior is adjusted to fit and respond to the demands made upon it by domestic life.

The structuring of behavior is accomplished by the differential presentation and withdrawal of reinforcement or punishment. Since behavior is fluid, it is important that the reinforcing or punitive events coincide exactly with the behavior being strengthened or weakened. Unfortunately, dogs cannot be directly reinforced with most tangible rewards (e.g., food and petting) at the exact moment that they emit the target behavior, especially if the behavior occurs while they are some distance away. Also, in order to make punitive events effective, they must be timed to coincide with the occurrence of the target behavior.

Conditioned Reinforcement and Punishment

These problems are solved by using remote stimuli that temporarily take the place of the reinforcer or punisher until they can be delivered to the dog. On the one hand, the so-called *bridging stimulus* or *conditioned reinforcer* (S^r) serves to bridge the emission of the target response with the acquisition of a positive reinforcer. In contrast, the *conditioned punisher* (S^p) suppresses unwanted behavior by its being associated with the loss of an expected reinforcer or the impending presentation of a punishing aversive event. Conditioning the S^r is a Pavlovian process in which the bridging stimulus (e.g., "Good") is repeatedly paired with the presentation of the positive reinforcer or the termination of a negative reinforcer. On the other hand, a conditioned punisher is produced by pairing the bridging stimulus (e.g., "No") with the loss of positive reinforcement or the presentation of an aversive punishing event.

Additional Characteristics of Positive Reinforcement

The reinforcer is conceptualized as a contingent event capable of satisfying some biological necessity or drive that, when presented upon the emission of some behavior, will make the occurrence of that behavior more likely under similar circumstances and states of motivation in the future. For example, the presentation of a biscuit to a hungry dog after sitting will make the dog more likely to sit in the owner's presence in the future when hungry. But actually reinforcement is much more complicated than this reward paradigm suggests, exhibiting many irregular and, perhaps, unanticipated characteristics. For example, while the opportunity to eat represents a strong reinforcer for a hungry dog, the dog may also find just smelling the food reinforcing (Long and Tapp, 1967). There are several other characteristics of positive reinforcement that should be kept in mind: The incentive (or conditioned reinforcement associated with the work and the anticipation of reinforcement) may be more strongly reinforcing than the actual reward or unconditioned reinforcer itself. Highly desirable rewards may generate faster acquisition of simple skills but retard the acquisition of more complicated ones. Large food rewards generate an enthusiastic performance while the food is available but result in learning that is more prone to extinction when it is withdrawn. Smaller rewards may not generate very much enthusiasm initially but learning acquired under the control of small rewards is more resistant to extinction. Finally, slow, steady learning is the most resistant to extinction (Tarpy, 1982).

Motivation, Learning, and Performance

A dog's performance is a direct reflection of its past history of reinforcement and its current motivational state or readiness to act. For positive reinforcement to be effective, a dog must be in a state of need that can be satisfied only after the dog behaves in a predetermined way. The most commonly employed reward in animal training is food. As a reward, food is effective only so long as dogs are either hungry or sufficiently interested in the food item being used. Utilizing a dog's hunger drive together with its added willingness to work for special treats promotes the strongest effect. Although puppies will readily work for kibble, it is not usually sufficient to offer a dog the regular ration of food in a piecemeal fashion. Similarly, training dogs immediately after eating will negatively impact food as a positive reinforcer, as well as impede the development of classically conditioned appetitive associations. Combining food deprivation together with the presentation of special treats produces the best training results. The term *deprivation* means scheduling training sessions before meals rather than after them. The meal itself can be given to reinforce the overall training session as a sort of jackpot.

Although the provision of food is a powerful reward, it is not the only positive reinforcer available to trainers. In fact, anything the dog finds desirable can be used as a reinforcer. Although it has been argued that petting and praise may not possess sufficient re-

ward value to strengthen newly acquired behavior (Romba, 1984), controlled studies by Fonberg and Kostarczyk (1980) contradict this view, demonstrating conclusively that petting and verbal praise are viable social rewards for dogs. These researchers trained dogs under experimental conditions to perform a series of simple exercises (sit, paw, and down) with great efficiency and rapidity using petting and praise alone. To some extent, the pleasure from petting is an acquired taste and dependent on the degree of attachment and familiarity between the dog and the trainer. Bacon and Stanley (1963) found that running speeds in puppies were differentially affected by the amount of social contact that they received prior to testing, with puppies exposed to "satiating" contact running slower than "deprived" counterparts. The authors note that these effects are analogous to the increased instrumental responsiveness of rats exposed to food or water deprivation prior to training. In addition to petting and praise, the opportunity to go for a walk, ball play, access to chew toys, bouts of play, and access to other dogs—all represent potentially reinforcing events for dogs interested in obtaining such activities. Each activity, however, yields only a limited reward quotient, depending on the dog's need for the offered activity. A dog that has just undergone a long ball-play session will probably find additional ball play less reinforcing than access to a chew toy or a moment of rest. Similarly, a dog that has been engaged in chewing will not likely choose additional chewing over an opportunity to go for a walk. Reward training should not be restricted to food reinforcement alone. In fact, the reward value of food is relative to a dog's momentary motivational state of hunger. Under certain circumstances of satiation, a dog might actually find food punitive in comparison to an opportunity to play.

Antecedent Control: Establishing Operations and Discriminative Stimuli

The manipulation of motivational states conducive to learning is referred to as *antecedent control*. Some forms of antecedent control remain outside the trainer's direct influence (e.g., genetic and biological factors such as breed-typical tendencies, inherited traits, and some behavioral thresholds). In addition to setting events such as hunger, thirst, biological condition, medications, and general social needs, several other forms of antecedent control are under the direct influence of the trainer. These include establishing operations (e.g., reinforcer sampling or priming and a variety of transient motivational changes conducive to instrumental learning); discriminative stimuli (e.g., signals and commands-setting occasions when reinforcement is most likely to follow some specified behavior); and conditioned stimuli (conditioned attractive or aversive establishing operations). An establishing operation (EO) is a motivational antecedent that influences the extent to which a particular outcome (reinforcer or punisher) will strengthen or weaken the behavior it follows. According to Michael, an EO is an "environmental event, operation, or stimulus condition that affects an organism by momentarily altering (a) the reinforcing effectiveness of other events and (b) the frequency of occurrence of that part of the organism's repertoire to those events as consequences" (1993:192).

Setting events and EOs are of great significance for behavior modification because their manipulation alters the relative effectiveness of reinforcement and punishment. For example, the presentation of food to a hungry dog may be highly reinforcing, whereas if the dog is sick or sated, the food reward may not function as a reinforcer at all. In fact, in such cases, the presentation of food may punish the behavior that it follows. Further, manipulating EOs increases or decreases the likelihood that some class of behavior associated with the reinforcer or punisher will or will not occur. In the case of a hungry dog offered a noncontingent treat (reinforcer sampling), the dog will be more likely to beg, increase activity levels, or emit other behavior that has successfully obtained food in the past. A similar effect is achieved by briefly giving the dog a ball to play with, then making continued access to it contingent on some required behavior.

A warning or threat may function as an

EO for avoidance behavior, thus making it more likely that the dog will respond to a command previously associated with negative reinforcement. A failure to sit, for example, followed by "No!" will raise the likelihood that the dog will sit when the command is repeated. In this case, the reprimand "No!" is an EO making the sit response more likely to occur in the presence of the vocal signal as well as enhancing the effect of negative reinforcement when the dog sits. Obviously, an EO and a discriminative stimulus (S^D) (e.g., "Sit") share a functional relationship as antecedent variables controlling the occurrence or nonoccurrence of both wanted and unwanted behavior. In the case of reinforcement, the EO raises the likelihood that some particular behavior will occur and be effectively reinforced, whereas the S^D precisely defines the occasion when the response is most likely to produce the reinforcer, that is, the EO exercises *motivational control* while the S^D exercises *stimulus control.* Identifying EOs and S^Ds controlling unwanted behavior is vital for effective behavioral intervention. By manipulating EOs and altering or eliminating controlling S^Ds associated with unwanted behavior, such behavior is rendered much more responsive to modification. Secondly, by properly manipulating motivational states, more desirable alternative forms of behaviors can be easily shaped and brought under control.

Premack Principle: The Relativity of Reinforcement

The usual way reinforcement is described emphasizes its *stimulus* characteristics and their potentiating effects on behavior, but reinforcement can also be analyzed in terms of the potentiating effects that responses have on other responses. David Premack (1965), who performed a number of experiments supporting this sort of analysis, has demonstrated that behavior occurring at a high frequency or probability tends to reinforce behavior occurring at a lower frequency/probability. According to this perspective, the determination of whether any particular behavior is a reinforcer (or punisher) depends on its relative probability with respect to the behavior it follows. Premack states this relationship in terms of response probability: "For any pair of responses, the independently more probable one will reinforce the less probable one" (1962:255).

If one distributes the dog's behavior on a hierarchy or continuum ranging from low to high response probability, then, according to the *Premack principle*, behaviors ranked higher up on the hierarchy of probability will tend to positively reinforce ones ranked lower down. Alternately, if a response occurring lower on the probability hierarchy follows one ranked higher up, the relationship is punitive—that is, the higher-ranked antecedent response will be rendered less probable by the lower-ranked consequence. Therefore, reinforcers and punishers are relative and dependent on a dog's transient behavioral tendencies and motivational states.

Instead of conceptualizing the reinforcing event as a stimulus, Premack describes it in terms of an indivisible S-R composite. For example, a biscuit for the hungry dog is both stimulus (something to be eaten) and a response (the act of eating it). These observations emphasize an important difference between instrumental and classical conditioning. Responses reinforce responses in the case of instrumental learning, whereas stimuli reinforce stimuli in classical conditioning.

A significant factor in the foregoing paradigm of reinforcement is the role of response-activity deprivation (Timberlake and Allison, 1974). Any behavior can be made more valuable and, therefore, more probable by depriving the animal access to it. Similarly, any behavior can be made less valuable and punitive by satiating the animal with it, thus making it less probable. Further, the value of any given reward is dynamic and dependent on the animal's changing sensory needs and the attainment of what Wyrwicka (1975) has described as a *better state* of being.

During an ordinary training session, the dog is going to prefer performing some exercises more than others. Determining at any moment what the dog would prefer to do and then providing access to that activity on a contingent basis is a sound and efficient incorporation of the Premack principle. For in-

stance, having a dog heel out of a down-stay is a reinforcing consequence for staying, regardless of what else is done to strengthen the down-stay exercise. Although there appears to be a natural inclination for active exercises to reinforce stationary ones, this is not always the case. For example, if a dog is made to heel for a long period without stopping, the dog's inclination to sit or lay down will gradually become stronger than its inclination to continue heeling. When the dog is finally permitted to sit or lay down, the opportunity to rest will tend to reinforce the previous heeling pattern.

Another example involves the trained habit of coming when called from the sit-stay. Most dogs find coming when called preferable to staying still in the sit position. Consequently, even in the absence of other rewards, the sit-stay is reinforced when the dog is called by its handler. However, having the dog come and then to sit-front may have a contrary effect. In this situation, the dog moves from a highly reinforcing activity (coming) into a less reinforcing one (sitting). The overall effect is mildly punitive. Therefore, at the outset of recall training, it is better not to require that dogs perform the customary sit-front each time they come. Instead, it would be consistent with the Premack principle to follow the performance of coming with an even more exciting and reinforcing opportunity, for example, an immediate opportunity to play ball. An alternative approach would be to train the sit-front to a high degree of proficiency, thus making it highly probable, and then to chain the less probable recall response to it.

LEARNING AND THE CONTROL OF THE ENVIRONMENT

Just as expectancies are formed between a conditioned stimulus and the occurrence or nonoccurrence of a corresponding unconditioned stimulus in classical conditioning, a similar contingency relation appears to exist between the instrumental signal, response, and reinforcing outcome (Rescorla, 1987). Instrumental acquisition, schedules of reinforcement, and extinction can all be described and understood in terms of a rein-

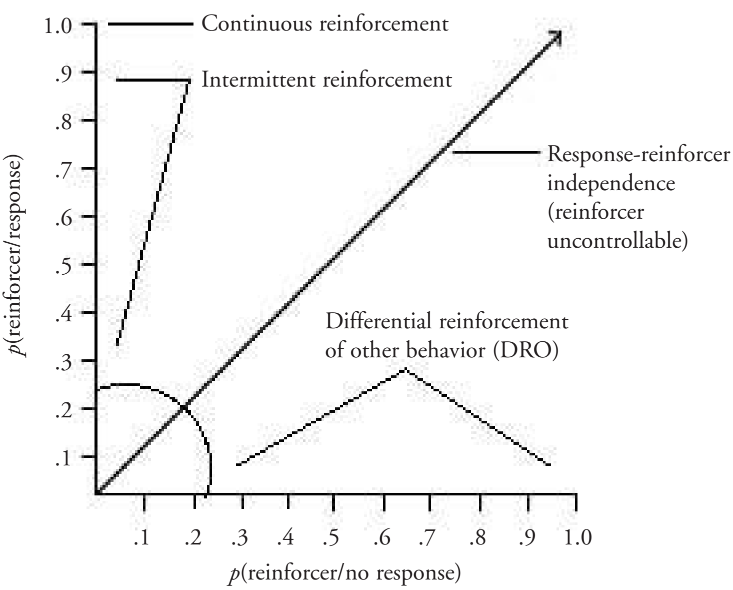

FIG. 7.2. Diagram showing various general contingency relations between the reinforcer and the occurrence or nonoccurrence of the instrumental response. After Seligman et al. (1971).

forcer-response contingency. Figure 7.2 illustrates various contingency relations between the reinforcer and response, ranging from a situation in which the reinforcer is certain to follow the response each time it occurs (continuous reinforcement), to intermittent reinforcement, and, finally, to a condition in which any response *other than* the specified one is followed by reinforcement (differential reinforcement of other behavior—see below). The most problematical contingency is represented by the diagonal line in the diagram. Here the animal is exposed to a situation in which reinforcement is equally likely to occur whether or not the specified response occurs—that is, the reinforcer and response occur independently of each other. Under conditions of appetitive training, the noncontingent presentation of food may result in various interference effects collectively referred to as *learned laziness*. On the other hand, under conditions in which aversive stimulation is presented on a noncontingent basis, a number of devastating interference effects called *learned helplessness* may ensue, impeding normal escape and avoidance learning.

The unpredictable or noncontingent presentation of rewards or punishers may adversely affect the learning process in many ways. Habitually providing dogs or puppies with gratuitous affection and treats without clearly defining a causal linkage between such rewards and the animals' behavior may lead them to conclude that their behavior does not play an instrumental role in obtaining such outcomes. Such "spoiled" puppies are more prone to develop adjustment problems and become more difficult to train as adults. Early training that encourages puppies to earn desirable resources and activities in exchange for appropriate behavior is fundamental to rearing well-behaved and adjusted puppies. Evidence supporting this view has been found by comparing rats that had obtained varying amounts of free food (i.e., food presented noncontingently with respect to their behavior) with rats who received food on a contingent basis (Seligman, 1975). When later tested and compared on a simple lever-press task, the spoiled or "lazy" rats learned the target response much more slowly than unspoiled controls:

> Different groups of hungry rats had pellets of food dropped "from the sky" through a hole in the roof of their cage, independently of their responses; then they had to learn to get food by pressing a bar. The more free food they had received in pretraining, the worse they did at learning instrumental responses for food. Some of the rats just sat around for days, waiting for more food to drop in; they never pressed the bar. (Seligman, 1975:34–35)

Wheatley and colleagues (1977) performed a series of controlled experiments exploring the interference effects of noncontingent rewards on subsequent appetitive learning in rats. The results substantially support Seligman's observations. They found that rats exposed to noncontingent food during pretraining sessions performed at a much lower level in comparison to rats pretrained to perform a simple response to obtain the same food. Lack or loss of controllability of positive outcomes affects not only subsequent appetitive training but also the animal's ability to learn aversive contingencies—that is, the interference effect is cross-motivational (Sonoda et al., 1991).

Another source of concern regarding noncontingent rewards is the adventitious reinforcement of unwanted behavior and, perhaps, the development of superstitious behavior. Although B. F. Skinner's famous study and demonstration of superstitious behavior in pigeons has been widely cited as evidence for such learning, unfortunately it has not been experimentally duplicated. In fact, a more detailed study by Staddon and Simmelhag (1971) failed to show confirming evidence for the sort of bizarre and idiosyncratic superstitions observed by Skinner in his earlier experiment (Skinner, 1948). Although superstitious behavior may develop from time to time as the result of adventitious or noncontingent reinforcement, the form described by Skinner is probably not very common among animals.

In the case of unpredictable and uncontrollable aversive stimulation, the effects are even more pervasive and debilitating. Common sources of such stimulation include noncontingent punishment and negative reinforcement applied without adequate avoidance cues. Following the application of such

improper punishment, the owner may futilely attempt to explain the cause of the "surprise attack" with meaningless verbal admonitions and directives. Of course, to the bewildered and frightened dog, all of this only adds to the confusion.

Sadly, many dogs are subjected to a daily round of punishment and affection based largely on an owner's shifting moods. In general, the loss of control over significant events via the noncontingent presentation of appetitive or aversive stimuli results in reduced operant initiative and retards associative learning processes. Dogs habitually exposed to excessive noncontingent punishment tend to become overly cautious, nervous, and insular. Their experiences with punishment have taught them that they can neither predict nor control such aversive events. Consequently, they learn to take punishment passively as an inevitable outcome rather than learning from it. They appear to be pain insensitive or extremely stubborn, sometimes failing to learn the most simple training exercises without exhibiting great difficulty, resistance, and struggle. They are often passively resistant and withdrawn. They appear to be mentally paralyzed; lacking normal voluntary initiative, they must be physically prompted or forced through every step of the training process. They are frequently stiff with muscular tension as though anticipating the worst and bracing for it. Because of their negative outlook, such dogs are very difficult and draining to work with, resisting every effort to increase their interest and enthusiasm. They often refuse food, reject invitations to play, and are unresponsive to petting. They are typically hypervigilant and suspicious. These behavioral effects of uncontrollable punishment are consistent with the symptoms of *post-traumatic stress disorder* (PTSD) and what Seligman has collectively termed *learned helplessness* (see Chapter 9).

SCHEDULES OF POSITIVE REINFORCEMENT

One of the most important contributions of B. F. Skinner to training theory was the elucidation of various reinforcement schedules and their differential impact on the performance of learned behavior (Ferster and Skinner, 1957). In dog training, reinforcement is provided according to various plans and schemes depending on the specific requirements of the training objective. During the early stages of training, a new behavior is reinforced every time it occurs. The new behavior is acquired on a continuous schedule of reinforcement (CRF). Once a stable operant level is obtained, the behavior is usually brought under the control of an intermittent schedule of reinforcement. Intermittent schedules require a dog to emit a prerequisite number of responses (ratio schedule), emit at least one response within a predetermined period of time (interval schedule) before reinforcement is delivered, or emit the target behavior continuously over some period of time (duration schedule). All three schedules can be either fixed or variable. In combination, therefore, three basic schedules of fixed and variable reinforcement are possible: (1) fixed and variable ratio (FR/VR), (2) fixed and variable interval (FI/VI), and (3) fixed and variable duration (FD/VD).

An FR schedule of reinforcement requires that a dog emit a fixed number of responses before reinforcement is presented. For example, requiring a dog to sit three times before giving it a treat is an FR 3 schedule of reinforcement. A VR schedule is set according to an on-average occurrence of reinforcement. For example, a dog reinforced randomly on the first, third, or fifth time it happens to sit would be maintained on VR 3 schedule of reinforcement. Interval and duration schedules are also applied on a fixed or a variable basis. For instance, an interval schedule only requires that the dog sit at least once during some fixed or variable period of time. On the other hand, a duration schedule involves a fixed or a variable length of time during which the response must be continuously emitted before reinforcement is delivered. A common example in dog training that utilizes a duration schedule is the stay exercise. A dog required to sit and stay for a period of 30 seconds before being reinforced is working on an FD 30s schedule of reinforcement. If the dog is required to sit for varying lengths of

time, but on average for a 30-second duration, then the dog is working on a VD 30s schedule.

An important benefit of intermittent reinforcement is that it makes the selected behavior more resistant to extinction. While a CRF schedule will result in fast, steady acquisition, if reinforcement is suddenly withdrawn, the learned behavior will extinguish with a corresponding rapidity. The foregoing reinforcement schedules outlined require that a dog emit more responses for the same amount of reinforcement. The effect is to "immunize" the learned behavior against extinction should reinforcement not always be forthcoming. Not only do the various schedules (especially the VR schedule) cause instrumental behavior to become more resistant to extinction, they also stimulate dogs to work even harder for a comparatively smaller reinforcer. This added benefit allows for an easy transition from tangible rewards like food to less tangible social rewards like petting and praise. When food is used during the acquisition phase, it is usually *faded* as soon as possible and replaced with various social rewards sufficient to maintain the learned behavior. Finally, intermittent schedules are very important in shaping procedures where a previously established approximation must give way to the next step in the program of contingencies without causing the dog to quit.

Everyday Examples of Reinforcement Schedules

The influence of reinforcement schedules can be observed in many everyday situations. Imagine, for example, the behavior of a person who had just thrown the switch of a lamp and discovered that it did not work. What will he or she do to remedy the situation? Some reasonable efforts might include turning the light switch on and off a couple of times, checking whether the plug was properly inserted into the electrical outlet, or even looking for some other possible causes to explain the failure (e.g., a defective bulb, switch, or fuse). But one would not expect the person to turn the light switch on and off again repeatedly in a vain effort to make it work. This latter option is unlikely because of the sort of reinforcement schedule controlling the "switch turning" behavior. The habit of turning the light switch on was acquired on a continuous schedule of reinforcement. In the past, the lamp had responded as expected on nearly every occasion the switch had been thrown. Under such conditions of reinforcement, a single failure of the light to work as expected disconfirms the entire pattern of reinforcement, resulting in its rapid extinction.

Similarly, if one were to insert a quarter into a pay phone and received neither a dial tone nor the coin in return, one would probably not continue to insert additional coins hoping that it might finally work. Both these examples illustrate the primary weakness of continuous reinforcement—the sensitivity of such schedules to the effects of extinction. Of course, extinction in these situations is only temporary. Both of these habits quickly recover as soon as they are reinforced again, that is, when the lamp is repaired or after a working pay phone is found.

A similar effect can be seen when dogs are trained on a CRF schedule. They, too, learn to "expect" the presentation of a reinforcer for each behavior they emit. If this pattern of continuous reinforcement is discontinued, dogs will refuse to emit the behavior. However, once the accustomed reinforcement schedule is reinstated, their willingness to perform will rapidly recover to previous levels. The foregoing observations suggest that dogs do not learn a *habit* per se, but rather a *set of instrumental contingencies* consisting of available outcomes, rules for their acquisition, correlated expectancies (given that they follow the rules), identification of the stimulus situations in which the rules apply, and an overall confirmation or disconfirmation of the learning set based on prior experience.

Comparing the foregoing example of switching on a lamp with that of starting a car reveals several important differences between continuous and intermittent schedules of reinforcement. While my car usually starts on the first attempt, I have learned to expect that occasionally it may take two or three additional efforts before starting. On some oc-

casions, though, when it is extremely cold or wet outside, the car may require much more sustained effort and prompting to get started. Under these reinforcement contingencies, a warm sunny day has become a discriminative stimulus (S^D) under which circumstances my car usually starts easily on the first attempt. A cold dreary day, on the other hand, has become an S^D predictive of difficulty starting the car but usually promises success for sustained repeated effort. Under the conditions of warm and dry weather, I will be more likely to quit trying after only a few efforts and consider various mechanical failures instead. However, under weather conditions involving cold and heavy rain, I am more inclined to try many more times before giving up. The prevailing S^Ds in the first case cause me to *match* my efforts to predictions based on a CRF schedule, whereas in the second case my behavior is matched to predictions based on an intermittent VR schedule. As the second case demonstrates, behavior under the control of intermittent scheduling tends to persist even under adverse reinforcement contingencies.

HOPE, DISAPPOINTMENT, AND OTHER EMOTIONS ASSOCIATED WITH LEARNING

Training events produce various expectancies and presumptive states of emotional arousal, ranging from frustration and disappointment to relief and hope (Fig. 7.3). In addition, anger, fear, and anxiety are commonly associated with aversive training techniques (see Chapter 8). As the foregoing examples illustrate, continuous reinforcement schedules tend to generate expectancies based on some degree of certainty (elation), whereas intermittent reinforcement schedules tend to generate expectancies based on probability

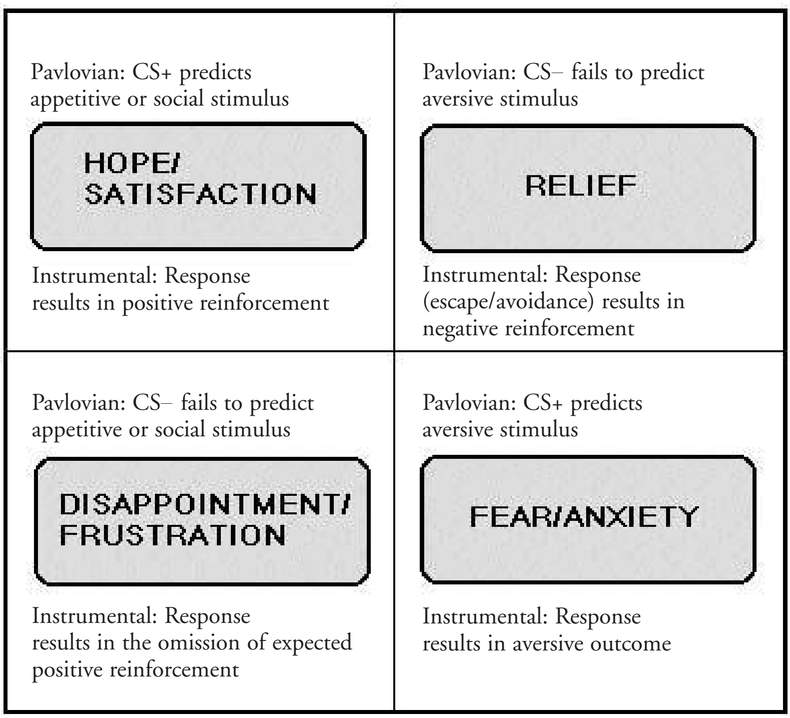

FIG. 7.3. Both classical conditioning and instrumental learning generate emotional arousal including hope, satisfaction, relief, disappointment, and fear. After Mowrer (1960).

(hope). When the light switch fails, I do not try over and over again hoping that it will eventually work. I may switch it on and off one or two times out of frustration or bang the broken pay phone out of anger (perhaps, with some hope of dislodging a sticky coin because of intermittent successes in the past by doing so), yet, almost as soon as my car fails to start on the first try, I begin to hope that it will start sooner rather than later.

Conditions of intense hope easily transport the subject into irrational realms of superstition and compulsivity. Hope is a controlling motivational factor in most games of chance. The actual outcome of gambling (the purse, etc.) is not as important as the associated elation of having won, an elation that is significant in terms of having avoided the disappointment of losing. Slot machines are programmed to pay off on a VR schedule. The behavior exhibited by players of such machines is virtually identical to the behavior of laboratory animals working under intermittent reinforcement. Individuals engaged in lever pulling for quarters are probably little interested in actually winning money (slot-machine players typically lose much more money than they win) as much as they are motivated to experience the sheer pleasure and elation of winning and avoiding the painful disappointment of losing.

Many of the effects occurring under ratio schedules can also be observed in behavior controlled by duration or interval contingencies. Dogs trained to sit-stay on an FD schedule will stay only as long as the duration to which they have been accustomed is not exceeded by too much time. For example, a dog trained to stay for a period of 5 seconds (FD 5s) will probably get up after 7 seconds or so if not rewarded. Rewards presented on an FD schedule establish an expectancy of certainty based on past learning experiences in which reinforcement always occurred within a fixed period of time. If this general expectancy is violated by making the dog stay longer without some transitional training, the stay performance will deteriorate under the influence of disappointment, at least until the previous duration contingency with which the dog is accustomed is reinstated.

FI schedules, like FR schedules, are very sensitive to extinction. For example, receiving a paycheck after a week of work is a common expectancy for the average working person. The strict regularity of this outcome may cause the worker to quit his or her job (depending on the presence or absence of other controlling reinforcers in the workplace) if the expected payment did not occur when promised. An employee working on a commission basis might be much more flexible, since he or she is accustomed to a VI schedule in which payments occur more randomly. A worker paid on a commission basis might persist for long periods between paydays based on the hope of an eventual payoff or a big bonus. Under normal circumstances, FI schedules are rare in comparison with VI schedules. FI schedules control behavior patterns based on expectancies of certainty, whereas VI schedules tend to generate expectancies of hope.

In general, behavior based on expectancies of certainty is vulnerable to disappointment, but behavior based on expectancies of hope is more persistent and motivationally *immunized* against the adverse influences of disappointment.

Matching Law

The ability to choose between alternative courses of action is a behavioral imperative that enables an animal to adjust purposefully to the moment-to-moment demands presented by the environment. Choice behavior is influenced by the history of reinforcement produced by past choices made under similar conditions. The general pattern of choice-making is highly correlated or *matched* with the relative reinforcement value of the available alternatives presented to the animal from which to choose.

Expectancy and Matching

An important influence on choice behavior is *expectancy*—a cognitive construct—combining classical information (relative predictability) and instrumental information (relative controllability) derived from experience (Fig.

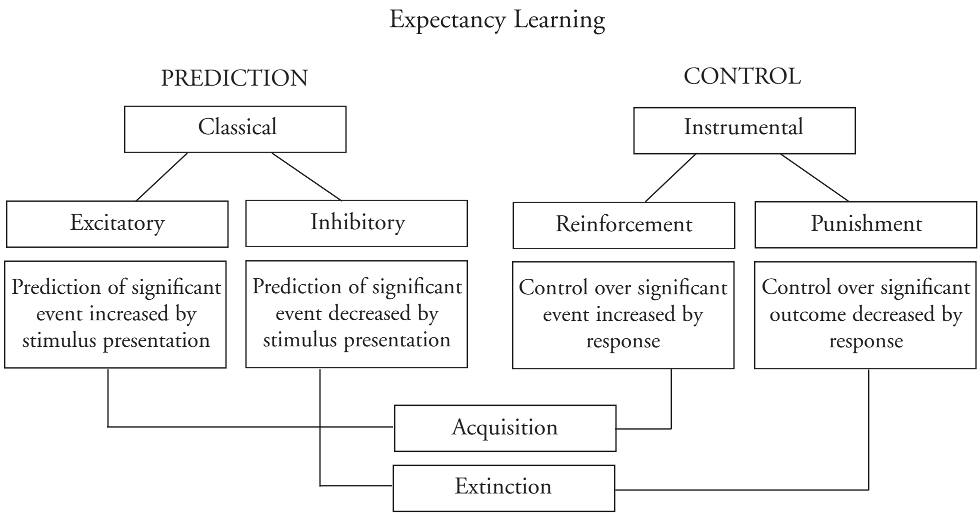

FIG. 7.4. Diagram showing various interactions between prediction and control in the formation of behavioral expectancies and learning.

7.4). Expectancy is constantly undergoing adjustment according to whether predictions have been accurate and whether control has been successful. This general process of confirmation and disconfirmation is a vital link between learning and performance. A learned behavior whose performance in the presence of a particular cue leads to an expected outcome is confirmed and its probability of future performance under similar circumstances is strengthened, whereas a behavior that fails to result in an expected outcome is disconfirmed and its probability of future performance correspondingly weakened. Confirmation promotes the acquisition of behavior, whereas disconfirmation promotes extinction.

Prediction-control expectancies are not necessarily "conscious" calculations, although in many animals (including the dog), they may be conscious to some extent. On a most basic level, such behavioral expectancies are cognitive representations, or *schema,* derived from experience. These expectancies appear to differentially stimulate internal motivational substrates, exciting or inhibiting behavior—substrate changes that may be felt or experienced (e.g., anxiety, frustration, relief, elation) and variously may impede or invigorate behavior.

The statistical nature of expectancy is elegantly expressed in the tendency of animals to match their behavioral output to the relative reinforcement values offered by alternative choices. This ability to proportion behavior according to a matching rule was first described by Tolman and Brunswick (1935). According to them, the "causal texture" of the environment does not ordinarily produce firm expectancies; instead, an animal makes rough judgments based on probabilities of success or failure. This state of affairs entails a probability calculation based on the reinforcement history (reward and nonreward) of the particular class of behavior operating under particular conditions (cue-context relations). For example, Brunswick (1939) experimentally demonstrated that animals tend to apportion their behavior according to definite rules based on probability. In his early study of matching, rats were trained to run a T maze but were rewarded twice as often when they ran down one arm of the maze. That is, they were rewarded every time they ran down one arm but also received reinforcement every other time they ran down the opposite arm. An unexpected consequence occurred as

the result of this experimental arrangement: the rats learned to apportion their choices based on the availability of rewards. A ratio of 2:1 was observed between the two available choices. This is an interesting finding, since it appears to violate the principle of least effort, stating that an animal prefers the shortest or easiest route to any given goal. Ostensibly, it would seem much more easy and efficient for the animal to simply run down the right arm for a 100% rate of reward and avoid the left arm altogether! More recent formulations of the *matching law* have been devised, and the phenomenon has been confirmed in a variety of animals. One possible explanation for the added work output is the acquisition of valuable information about a less than optimal source of food.

Concurrent Schedules

Over the years, many experiments have demonstrated that animals will reliably distribute their responses proportionally between the two sources of reinforcement according to the relative value of reinforcement made available by the respective alternatives. This propensity to apportion responding according to the relative value of reinforcement is governed by the matching law, which states that "the relative rate of responding equals the relative rate of reinforcement" (Rachlin, 1976:562). For example, consider a pigeon working in an operant chamber with two functioning disks producing food on different concurrent variable interval schedules. The right disc is programmed to present reinforcement on a VI 20s schedule, while the left disc is programmed to present reinforcement on a VI 120s schedule. The pigeon will likely choose to peck on the right disc six times as often as the pigeon responds on the left disc. This is a rather extraordinary learning phenomenon with a wide phylogenetic distribution among animals (Bitterman, 1965).

Extinction of Instrumental Learning

Extinction is a procedure whereby a positively or negatively reinforced response is decreased in strength or frequency by discontinuing the contingency of reinforcement maintaining it. During the acquisition phase, dogs learn that reinforcement or its omission depends on what they do. Under the extinction phase, they learn that the desired or expected consequence is no longer available for the same response. This does not imply that extinction is the functional opposite of learning, nor is it a passive effect based on response fatigue or some other such phenomenon (e.g., habituation), but rather extinction is the result of additional active learning about the relevant discriminative stimulus (S^D), response, and outcome ($S^{R+/-}$). Extinction results when the controlling S^D fails to predict the occurrence of the expected outcome for which the selected response is emitted, that is, to control the presentation of the positive reinforcer (S^{R-}) or to escape or avoid the occurrence of the negative reinforcer (S^{R-}). Consequently, during extinction, dogs learn not to respond in the presence of the signal since it no longer adequately predicts the occurrence or nonoccurrence of the anticipated attractive or aversive stimulus. However, extinguishing a response under the control of one S^D or signal does not mean that it will be adversely affected in the presence of other signals that still adequately predict reinforcement. In fact, if the previously disconfirmed signal again becomes predictive of reinforcement, the erstwhile extinguished response will quickly recover to its original strength.

Extinction procedures are often used to reduce attention-motivated disruptive behavior that is under the control of social contingencies of reinforcement (Ducharme and Van Houten, 1994). For example, many puppies rebel against being restrained in their crate at night, often exhibiting strong protestations in the form of barking and persistent efforts to escape. A concerned owner may reinforce this behavior by either attending to the puppy or, worse yet, by releasing the puppy from confinement. In cases where such a history of reinforcement is evident, extinction by simply ignoring the puppy often proves very effective. An interesting parallel case has been de-

scribed by Williams (1959), in which a dramatic reduction of "tyrant-like tantrum behavior" was expressed by a 2-year-old child whenever he was put to bed. The child quickly responded to the extinction efforts carried out by the family, until one night the child exhibited a period of tantrum behavior (spontaneous recovery) while an aunt was watching him. This single reinforcing event caused the tantrum behavior to recover, requiring that another series of extinction trials be carried out. After a few days, the behavior was fully suppressed.

As mentioned previously, the rate of extinction depends to a great extent on the reinforcement history controlling the targeted behavior. Behaviors maintained under an intermittent schedule of reinforcement tend to be more resistant to extinction than ones maintained under a CRF. Characteristically, intermittent reinforcement also tends to produce higher rates of responding than does reinforcement occurring on a continuous schedule. In some cases, therefore, especially involving difficult-to-extinguish behavior, it may make sense to place the unwanted behavior on a continuous schedule before proceeding to the extinction phase of training. At first, this sort of behavioral intervention may seem highly questionable (i.e., deliberately reinforcing unwanted behavior), but the evidence is fairly clear—such an approach tends to reduce the overall rate of responding while rendering the behavior more vulnerable to subsequent extinction efforts. Lerman and colleagues (1996) have successfully tested and confirmed the efficacy of a similar approach with human subjects exhibiting disruptive and aggressive behavior.

Extinction Burst

When an instrumental response undergoes extinction, it may actually intensify before beginning to decrease in strength. For example, if one wishes to extinguish begging behavior by withholding food treats, the frequency and magnitude of begging behavior may initially increase to levels exceeding pre-extinction operant levels. This so-called *extinction burst* or frustration effect is usually followed by a gradual decrease in response strength until the behavior is finally extinguished over the course of several non-reinforced trials.

Spontaneous Recovery

After a day of rest following a series of extinction trials, a trainer may find that the behavior that he or she thought was extinguished the day before had meanwhile returned to nearly its full original strength. This phenomenon is referred to as *spontaneous recovery*, which frequently occurs after a rest period between extinction sessions. However, such recovered behavior is usually much more sensitive to subsequent extinction efforts, yielding more rapidly than before. Over the next several days, the begging behavior is apt to recover periodically but with progressively weaker strength and persistence. If the owner remains steadfast, the begging behavior will be eventually extinguished without further episodes of spontaneous recovery. If, however, the owner becomes lax or forgetful and gives the dog a *single* treat (intermittent reinforcement), future extinction efforts will be adversely impacted.

While extinction can be usefully employed to reduce the strength of an unwanted behavior, competing phenomena like bursts and spontaneous recovery make it an impractical training tool for many situations. Further, because extinction is essentially a punitive measure (the withdrawal of positive reinforcement is punishment), the dogs or puppies are not learning anything new—they are only learning that the behavior under extinction no longer produces the expected reinforcement. In the case of simple extinction, it is important to introduce and differentially reinforce an alternative or incompatible behavior to replace the one being extinguished.

DIFFERENTIAL REINFORCEMENT

There exist many ways to reduce the occurrence of unwanted behavior besides punishment and extinction. Perhaps the best initial approach to decrease unwanted behavior is to

reinforce some competing alternative behavior differentially while simultaneously simply ignoring the unwanted one (Skinner, 1953; Kazdin, 1989). There are three basic schedules of differential reinforcement: (1) differential reinforcement of other behavior (DRO), (2) differential reinforcement of incompatible behavior (DRI), and (3) differential reinforcement of low rate (DRL).

Differential Reinforcement of Other Behavior

The schedule for differential reinforcement of other behavior (DRO) provides reinforcement for any behavior provided that the unwanted one does not occur during a fixed period of time. DRO scheduling is especially suited to nuisance behaviors occurring at a high frequency. For example, puppies exhibiting excessive mouthing tendencies might accept petting for 5 seconds or so before engaging in the undesirable habit. It is important to determine this baseline interval accurately before beginning the training process. The first step is to reward the puppy after 5 seconds regardless of what he is doing as long as he is not mouthing and has not mouthed for at least 5 seconds. Once the 5-second requirement is mastered, the DRO schedule can be lengthened through gradual increments of duration, until he accepts longer periods of attention without mouthing. The DRO schedule directly impacts on the mouthing behavior by reinforcing other behavior occurring in its absence.

An important drawback of the DRO schedule is that an equally unwanted behavior might be inadvertently reinforced (Foxx, 1982a). The puppy in the foregoing example is reinforced at the end of a fixed period, provided that he does not mouth regardless of other behavior that might be going on. At the moment of reinforcement, the puppy may not be mouthing but he might be barking or jumping up, undesirable behaviors that could be easily strengthened as a result of reinforcement. Another drawback of the DRO schedule is that it does not require that the puppy learn anything new to replace mouthing—it only requires that the puppy not mouth or bite.

Differential Reinforcement of Incompatible Behavior

These problems can be mitigated by introducing a schedule for differential reinforcement of incompatible behavior (DRI) after the DRO schedule has reduced the frequency of the unwanted behavior into workable dimensions. Under the DRI schedule, the puppy is rewarded only if it performs an incompatible target behavior that is both motivationally and physically opposed to the unwanted behavior. In the aforementioned case of excessive mouthing, the target behavior might be licking. DRO and DRI schedules can be implemented together. For instance, the puppy can be reinforced after a predetermined interval of time, provided that no mouthing has occurred and that it licks at the end of the period.

The selection of reinforcement can help make this strategy even more effective. In many cases, the most desirable reinforcer is an opportunity to perform the unwanted behavior in a more acceptable form. This could be arranged by substituting an alternate object and activity in place of biting on hands. In the case of excessive mouthing, providing the puppy with a tennis ball, together with gentle tug and fetch games, is a quite satisfying outlet and alternative to mouthing on one's hands. This is a very constructive alternative, since ball play serves an important role in the puppy's future training. Excessive or persistent mouthing is often associated with dominance testing and may require additional training efforts to fully resolve.

Differential Reinforcement of Low Rate

The schedule for differential reinforcement of low rate (DRL) is similar to the DRO schedule in that a certain interval of time must pass between opportunities for reinforcement. In the case of DRL, the dog must emit a predetermined number of targeted responses over a fixed interval period or the entire interval is reset, thus further delaying re-

inforcement. The DRL schedule is also similar to a fixed interval schedule, except that any responses exceeding the required contingency reset the interval. DRL schedules are sometimes used in controlling excessive social behaviors that need to be reduced in frequency but not eliminated altogether. Though of technical interest in the laboratory, the DRL schedule is rarely employed in the management of dog behavior.

Attention Control

For most training purposes, attention can be divided into two broad categories: *orienting* and *attending*. Both forms of attentional behavior are controlled by a dog's name and other similar signals. The orienting response is governed by classical conditioning processes, as well as by the more primitive adjustment mechanisms involved in sensitization and habituation; Pavlov referred to it as the "What is it?" reflex. Although influenced and modified by learning, the orienting response actually precedes and makes possible learning in the first place—without the activation of the orienting response, no new learning is possible. Orienting behavior can be divided into four types of responses, depending on their strength: strong, moderate, weak, and no response. Typically, strong orienting reactions are evoked by the presentation of startling or surprising unconditioned stimuli. Moderate orientation is evoked by cues previously associated with appetitive or aversive events, weak orientation is stimulated by cues associated with highly predicted and controlled appetitive or aversive events, and, finally, no orientation is likely to occur in the presence of irrelevant or insignificant events.

Some stimuli unconditionally elicit an orienting response, whereas others develop the strength to do so only after conditioning. Commonly employed unconditioned orienting stimuli used in dog training include clapping, whistling, kissing sounds, clucking, yelling, and stomping. Note that many of these orienting stimuli involve the production of different kinds of sound. Audition is a particularly favorable sensory modality for attention training because it can be stimulated at a considerable distance and from any direction. The other sensory modalities (especially sight and touch) are not quite as accessible to stimulation as hearing but are nonetheless commonly used. Visual orienting stimuli used in attention training include changing body postures, waving the hands, running away from or toward the dog, tossing a ball or other object, or moving a laser pointer. Tactile orienting stimuli are commonly used, as well. Besides the use of touch as a physical prompt to get a dog's attention, various throw tools (chains or rings) are used in the case of dogs unresponsive to auditory and visual orienting stimulation.

To condition the dog's name as an orienting cue, it is paired with one of these unconditioned orienting stimuli. For example, just before clapping the hands to capture a distracted dog's attention, the dog's name is shouted out. After several pairings with a variety of orienting stimuli, the name becomes a generalized orienting signal. Unconditioned orienting stimuli can be strengthened by a process of sensitization. For example, the sharp clap of hands may after many repetitions become habituated. Its strength can be recovered by pairing it with a stronger unconditioned orienting stimulus like the crash of a shaker can. In this example, the trainer claps his or her hands and immediately thereafter tosses the shaker can in the direction of the distracted dog. After one or two such pairings, the dog will respond much more strongly to a clap alone.

The attending response requires that the dog exhibit sustained eye contact toward the trainer. One method for obtaining such control (described in more detail below) involves prompting the dog to look up by making a kissing or clucking sound and then appropriately bridging and reinforcing the response. At first, the dog is only required to look up briefly, but as training proceeds the requirement of duration is increased until the dog is holding eye contact for 3 to 5 seconds. Once the attending response is well conditioned, the dog's name is spoken just before the clucking sound is made. Gradually, the clucking prompt is faded and the dog learns to attend with sustained eye contact to his or her name alone.

Training and Stimulus Control

An important aspect of dog training involves bringing learned behavior under the control of cues and commands or what learning theorists call discriminative stimuli. Essentially, *stimulus control* refers to a process whereby a learned response is rendered more probable in the presence of some arbitrary stimulus. For example, once a dog has learned that some instrumental response is regularly associated with a specific outcome, the response-outcome relationship can be readily associated with a discriminative stimulus (S^D). The S^D functions similarly to a CS in classical conditioning, serving to establish a correlation between its presence and the occurrence of an associated instrumental response and reinforcer (Rescorla, 1991). The S^D is a signal that both selects the desired behavior and announces the moment when its emission will most likely result in reinforcement—that is, either producing a positive reinforcer or avoiding the occurrence of a negative one.

Shaping: Training Through Successive Approximations

Sometimes a behavior that is unlikely to occur spontaneously will need to be trained in gradual steps. This sort of training is called *shaping*. Shaping is a process in which a selected behavior is obtained by differentially reinforcing successive approximations of it. Shaping involves breaking down the training objective or target behavior into more manageable and easily learned parts. Many otherwise difficult behaviors can be efficiently trained by carefully arranging these component parts of the target behavior according to a plan or program of instrumental shaping contingencies. Shaping has many applications in dog training. Almost any response or behavior pattern within a dog's behavioral capability can be shaped as long as a few basic rules are followed. An excellent introduction to shaping dog behavior through differential reinforcement of successive approximations is provided by B. F. Skinner (1951).

The first step in the process is to prepare a conditioned reinforcer (S^{r+}**,** notice the little "r") by pairing a stimulus (e.g., "Good" or clicker/tone) with an unconditioned reinforcer (S^{R+}). The S^r is often referred to as *bridging stimulus*. Effective conditioning of the bridging stimulus is crucial to the shaping process. Before shaping can be effective, a dog must recognize that the bridging stimulus communicates at least two messages: (1) that its presentation is contingent on the emission of a particular behavior and (2) that its occurrences are linked with a remote but forthcoming reinforcer. Murphree (1974) recommends that 50 to 100 pairings between the S^r and food be carried out before using it as a bridging stimulus for operant-shaping procedures. In the case of ordinary training activities, far fewer pairings are needed.

Once the S^r has been conditioned, it should be tested to confirm that it meets the aforementioned criteria. The test can be carried out by using the S^{r+} to teach a simple behavior dependent on conditioned reinforcement for its acquisition. Normally, the behavior used to test the S^{r+} is the orienting or attending response—that is, the bridge stimulus is used to reinforce the behavior of following the hand prompt or looking into the trainer's eyes. Another possible shaping objective might be to train the dog to move toward an opposite corner of the training room. While this behavior is fairly simple, it will help illustrate the most salient features of shaping.

Step 1: Define the Goal or Target Behavior

It is important to define precisely the target behavior before training begins. *Training objective*: To train the dog to leave the handler's side on signal and walk to a predetermined corner of the room.

Step 2: Design a Plan or Program of Instrumental Contingencies

The target behavior should be broken down into as many simple parts as is practical. The plan for shaping the foregoing target behavior might include the following components:

1. The dog turns its head away.
2. The dog turns its head away and in the general direction of the corner.
3. The dog turns and moves its whole body away.
4. The dog turns and moves its whole body toward the corner.
5. The dog is required to move farther away.
6. The dog moves farther away and in the general direction of the corner.
7. The dog moves closer to the corner.
8. The dog enters the corner.

During the early stages, progress may be rapid, but as the requirements become more difficult, the acquisition curve may flatten out. Shaping is a dynamic process controlled by a feedback loop between the dog's progress and the program of instrumental contingencies. If progress is slow, renew momentum by going back a step or two. If the step still proves too difficult, break it down into even simpler elements. A program of instrumental contingencies should be flexible and opportunistic but never vague and capricious. Such adjustments to the plan, therefore, should not be made hastily or without good purpose. Each preceding step should receive enough training to make it a reliable foundation for the next step.

Once a step has been mastered, further requirements must be introduced that compel the dog to experiment with closer approximations to the target behavior. This transition is accomplished by reinforcing the previous step on an intermittent basis. This shift in reinforcement scheduling causes the dog to emit other related behaviors (response generalization) that might offer a higher rate of reinforcement. Placing previously mastered steps on an intermittent schedule is also important to prevent their extinction when selection pressures are made more demanding. Care should be taken, however, to avoid shaping transitions that cause the dog to quit, become overly anxious, or frustrated. When anxiety or excessive frustration appear, the trainer should go back to a previously successful step. Always end each training session on a positive note.

Step 3: Bring the Shaped Behavior Under Stimulus Control

Once the dog has reliably learned to go to the correct corner of the room, the new behavior can be brought under stimulus control. By overlapping the behavior with a hand gesture pointing in the same direction as the dog's movement, he will soon associate the gestural prompt with the movement of walking toward the designated corner. After many repetitions, a new contingency can be introduced requiring that the dog move toward the corner only when signaled to do so. All attempts to move toward the corner not initiated on cue are not reinforced. Such attempts can be overlapped with an S^{P-} "No," indicating to the dog that reinforcement is not forthcoming for the behavior. By reinforcing only those behaviors controlled by the gestural prompt, the dog soon learns to move only when prompted to do so. Once the gestural prompt controls the behavior, it is easy to bring the behavior under the control of a verbal S^D, for example, "Move." Pairing the S^D "Move" with the prompt results in the former acquiring the ability to control the shaped behavior. Once a sufficient number of trials have taken place, the gestural prompt can be gradually faded out, with the verbal S^D "Move" alone controlling the newly learned behavior.

The foregoing method of shaping is intended to provide the reader with a formal and structured approach. Under actual training situations, however, shaping is often carried out much more informally. The basic principles of breaking down the training goal into simple parts, organizing and teaching them in the most easily learned order, and carrying out training in a positively oriented manner are common features of all training activities. Shaping techniques provide the skilled trainer/behaviorist with powerful and efficient tools for orchestrating behavioral change through positive reinforcement. Pryor (1975, 1985) wrote at length on the use of operant-shaping techniques in the training of sea mammals and other animals, including dogs.

Adduction

Adduction refers to a training procedure in which a novel response is produced by combining two or more previously learned component repertoires. More specifically, adduction occurs when two previously learned behaviors are evoked by presenting their respective discriminative stimuli together. The resulting adducted response is reinforced and subsequently brought under stimulus control. For example, although training a dog to crawl can be accomplished by gradually shaping the crawling behavior through successive approximations or by utilizing appropriate physical prompts or props (e.g., a low table), the crawling behavior can also be obtained by signaling the evocation of two previously learned behaviors whose combined emission results in crawling. In this case, the dog might first be taught to heel and to lay down on signal. Once both behaviors are under stimulus control, the dog is signaled to lay down while heeling. In response to this arrangement, the dog may start to lay down but continue moving forward at the same time and, perhaps, begin to crawl. As a result, crawling behavior has been adducted from the combined occurrence of laying down and heeling. If the crawling response is reinforced under such circumstances, gradually it can be brought under stimulus control and then trained to occur independently of the antecedent component repertoires.

Chaining: Ordering Complex Performances

Training often requires that a sequence of arbitrary behaviors be structured so that they occur in a specific order. This order of occurrence is based on a predetermined continuity in which one behavior must always precede the next in a set sequence. Orderly sequencing is accomplished by making the advancement of the series contingent on the emission of a predetermined response occurring before the next one in the series is selected. To accomplish this goal, each task in the chain is brought under the stimulus control of a dual-functioning signal serving both to reinforce the correct antecedent behavior conditionally and to simultaneously select the next response in the series. This pattern is repeated until the entire sequence of behaviors is emitted and terminally reinforced.

Within the chain, each discriminative stimulus (S^D) provides conditional reinforcement for the behavior that it follows and simultaneously selects the next response. The S^D's dual function is an outcome of the way in which a chain is constructed. The chain is built up by connecting the final response with the terminal reinforcer and then adding on successive behaviors up to the origin of the chain. To obtain reinforcement, dogs must perform each response in the chain at the proper time. Each S^D in the chain not only selects the next behavior in the chain but also reinforces the preceding behavior because it advances the dog one step closer to the terminal reinforcer (S^{R+}).

Perhaps the easiest way to show how chaining works is to use a common example. The recall pattern involves a six-part chain: sit, stay, come, sit-front, finish, and sit. Both the terminal response and the origin are sit responses. Between the origin and the terminal response are four chained responses: stay, come, sit-front, and finish. These various components are linked through shared stimulus control and conditioned reinforcement. The chain is terminated with a sit response and final reinforcement at the trainer's left side. The terminal response is under the stimulus control of the S^D "Sit." "Sit" not only selects the terminal response, it also conditionally reinforces the preceding finish behavior. The next link is the finish behavior, which is brought under the stimulus control of the S^D "Heel." "Heel" not only selects the behavior of moving to the trainer's side but also conditionally reinforces the previous link in the chain—sit-front. Sit-front is under the stimulus control of the S^D "Sit," which not only selects the sit response but also conditionally reinforces coming. Coming is under the stimulus control of the S^D "Come," which also conditionally reinforces the dog for staying. The S^D "Stay" selects staying behavior and conditionally reinforces the sit response. The sit response is the origin of the chain and is

under the stimulus control of the S^D "Sit" (Fig. 7.5).

A far more common form of chaining in everyday dog training is called *forward chaining*. Although forward chaining lacks the behavioral elegance of backward chaining, it does offer many valuable features and several distinct advantages. Forward chaining requires only that a series of responses be performed on cue for a single reward. The forward chain is built up by placing each response component on an intermittent schedule of reinforcement and randomizing its occurrence in the chain sequence. Such a strategy of intermittent reinforcement and randomization results in the development of a hoped-for expectancy occurring equally with each link in the chain—a result that usually translates into a general strengthening of the chain, as well as immunizing component responses against extinction. It should be noted in the case of *backward chaining* that behaviors near the end of the chain are the most strongly reinforced, since they are the closest to the terminal reinforcer. In the case of forward chaining, responses near the origin of the chain are the strongest with the lure of reinforcement rapidly declining as the chain of responses is extended. Care must be taken, therefore, not to extend the forward chain too rapidly, perhaps causing a dog to quit. An important advantage of forward chaining is that it provides a means to place acquired behavior on an intermittent schedule. For example, instead of reinforcing a dog on every occasion for sitting, forward chaining might require the dog to perform any combination of the series stand, sit, down, sit from the down, and sit-stay for a single reward. Individual responses comprising the foregoing chain are conditionally reinforced at each step with praise ("Good"), but the final reward is presented only after the required sequence is performed or the whole series is completed successfully. Forward chaining teaches dogs to expect reinforcement after a certain amount of work, regardless of the actual behaviors performed. Also, the order of responses can be easily altered without significantly affecting the viability of the chain. The response order of a backward chain is locked in without much room for variability or change, other than shortening the chain by assigning the origin to a response closer to the terminal reinforcer. Also, if any of the behaviors in the backward chain fail (a highly likely outcome with responses near the origin of a long chain), the whole chain breaks down. Although carefully constructed backward chains can be immunized against extinction, the sheer complexity of the chain and the repeated occurrence of individual component responses without direct reinforcement make backward chains very sensitive to breakdown under natural training conditions.

PROMPTING, FADING, AND SHADOWING

One way of developing stimulus control is to first bring the target behavior under the control of a prompt (Foxx, 1982b). Kazdin defines a *prompt* as an event that initiates behavior to be reinforced:

> Prompts are events that help initiate a response. They come before a response has been performed and are designed to facilitate its per-

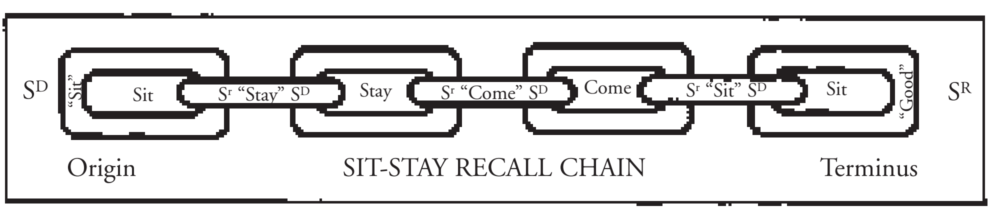

FIG. 7.5. Diagram showing the relationships linking together discriminative stimulus, response, and conditioned reinforcement in a chain of interdependent events.

> formance. When a prompt results in the response, the response can be reinforced. Without the prompt, the response might occur infrequently or not at all. Prompts serve as antecedent events (e.g., instructions, gestures) that help generate the desired response. (1989:42)

Prompting is divided into two broad categories: physical and gestural. A physical prompt involves actively manipulating a dog's behavior into the form desired, for example, pushing a dog's rump into a sit or guiding him into a starting position at heel with the leash. Physical prompting sometimes involves props such as walking a dog along a fence line to encourage him to stay close at heel. Physical prompts often become gestural prompts by being *faded*. The movement of the hand guiding a dog into the sit position can be gradually faded as a physical prompt and become a hand signal or gestural prompt. The transition between the faded physical prompt and the gestural prompt is facilitated by a technique referred to as *shadowing*. Shadowing is employed during the last stages of fading. Instead of touching a dog to make it sit, the hand is held slightly above, that is, *shadowing* over its rump.

Controlling hand signals are often established in conjunction with orienting prompts. The orienting prompt is developed by training a dog to follow the movement of the hand closely, sometimes even requiring that the dog actually touch the moving hand with its nose. Also, orienting lures, like a ball or stick, are frequently used to guide the dog into the desired behavior. Once the behavior is mastered, it is then brought under the control of a word cue or gesture while the orienting lure is simultaneously faded out.

Rehearsal and Staging

Successful modification of many behavior problems requires the use of rehearsal and staging techniques. *Rehearsal* involves having a dog master and repeatedly perform behavioral components needed for some later situation or remote context not present at the time of training. Although the situation or context itself may not be represented during rehearsal, each of the behaviors required can be independently shaped and ordered in the specific sequence needed. For instance, a socially overexuberant dog can be taught more appropriate manners independently of the presence of an actual guest. Of course, the actual situation when the guest arrives will be much more strained and charged than when the dog is home alone with the owner. It is important, therefore, that conditions be staged that more closely resemble the actual greeting as training proceeds. The effectiveness of rehearsal depends to a large extent on positive transfer and generalization. *Staging* allows previously rehearsed behavior to be performed under more natural conditions before exposing the dog to the actual situation. In the case of greeting behavior, someone familiar to the dog can play the role of the guest, making repeated entrances and exits under the control and direction of the trainer or owner. Rehearsal and staging have many applications in a broad variety of training and problem-solving situations, ranging from separation distress and fears to severe aggressive behavior.

Transfer of Learning

It is important that training readily transfer from one situation to another. Such transferability should not be taken for granted, especially in cases involving complex skills and discriminations. Learned behavior tends to *bond* with the training context in which it is conditioned and may not readily move to other situations without additional work. The relative familiarity or novelty of the training context exercises an important influence on learning. New tasks are most easily learned under familiar conditions, whereas already learned tasks can be improved upon by moving training activities into progressively more and more unfamiliar and distracting surroundings. Learning plateaus are most efficiently counteracted by varying the training environment. These observations strongly support the benefit of introducing general behavioral training as an in-home process and only later graduating into the more distractive group-training situations. Further, newly

acquired behavior is often state dependent, available only under the motivational states in which it was originally learned—for example, a dog trained to work for food might quit when no longer hungry. It is important, therefore, that training activities be carried out under a wide variety of motivational states in addition to changing the environmental contexts under which training takes place. Occasionally, a dog may be medicated with psychotropics or tranquilizers while undergoing training. Drug-dependent learning is a potential problem that must be carefully guarded against to ensure that a dog's ostensible progress is not dependent on a drug-induced motivational state.

Positive and negative transfer of training is a complex area of learning theory. Previous training that facilitates the acquisition of subsequent training is said to produce *positive transfer*. On the other hand, the effect of earlier learning that impedes subsequent acquisition is referred to as *negative transfer*. An interesting and paradoxical example involving transfer of training can be seen in a learning phenomenon known as the *overlearning-reversal effect* (Hall, 1976). The simplest experiment demonstrating this phenomenon would involve two groups of animals that are each taught a simple two-choice discrimination task. After achieving equal criterion levels, one of the two is given several additional training trials while the other one rests. Afterward, the discrimination is reversed so that the negative stimulus now becomes positive, and both animals are then tested on this new discrimination problem. One might guess that the animal receiving the additional trials would find it more difficult to learn the reversal (negative transfer) than the one receiving less training on the previous (now reversed) discrimination. Surprisingly, however, the effect of additional training facilitates learning of the reversal—that is, the animal receiving the extra training learns the new discrimination more quickly than its counterpart. The overtrained animal's success may have been due to added discriminatory skill developed as the result of its additional training. The overlearning studies tend to support a cognitive interpretation over a traditional S-R interpretation of discrimination learning.

Positive transfer is observed in situations where previous learning experiences facilitate the acquisition of new behaviors. For instance, a dog that has been trained not to jump up on its owner will be much more easy to train not to jump up on guests. Negative transfer often occurs in cases where previous learning is antagonistic to the acquisition of the target behavior. For example, puppies that have been exposed to a history of chase and evasion games will be much more difficult to train to come than counterparts without such experience. In the design of training systems, it is important to always keep in mind the influence of negative and positive transfer when ordering training events, so that it is organized in the most efficient and synergistic way possible.

Behavioral Contrast and Momentum

Behavioral contrast (matching) and momentum exercise powerful indirect influences on the overall effects of training, its transfer, and degree of permanence (Chance, 1998; Nevin, 1998). Behavioral contrast refers to the tendency of a target behavior undergoing reinforcement in one situation to occur less often in other situations where reinforcement is less likely to occur. Conversely, in comparison to baseline levels present prior to the onset of training, a behavior undergoing punishment in one situation will tend to occur relatively more frequently in other situations where it is less likely to be punished. Such effects are related to the matching law as already discussed. For example, if a dog's sitting behavior is exclusively rewarded only during formal obedience classes and practice sessions, the dog will be less likely to sit in everyday situations where reinforcement is not as likely to be forthcoming. Similarly, if a dog's social excesses (e.g., jumping up) during greetings are undergoing punishment in one situation but are permitted to occur at other times without consequence, the target excesses may significantly increase in those situations where punitive contingencies are not consistently in place.

Behavioral momentum is an important consideration when evaluating a particular

behavior's resistance to change and its tendency to recover at the conclusion of therapy or training. Such momentum is represented in terms of the target behavior's operant baseline levels present at the outset of training, its relative resistance to change (as measured by its responsiveness to modification), and its tendency to persist, that is, its proclivity to recover after training is discontinued. Some undesirable activities of dogs are affected by powerful momentum influences that adversely compete with training efforts, thus making such behavior highly prone to recovery at the conclusion of training. For example, jumping up, playful biting on hands, and pulling on the leash are all influenced by a high degree of behavior momentum. Not only do they occur at a high operant level, they also resist disruption by behavioral means and tend to recover when training is discontinued. To overcome the detrimental influences of behavioral momentum, alternative behaviors must be adequately practiced and reinforced until they acquire sufficient momentum of their own to offset the recovery of unwanted behavior simultaneously undergoing behavioral suppression or extinction.

Social Learning

The effect of others exercises a tremendous influence on the efficient acquisition of learned behaviors and their performance. A dog's social dependency makes it keenly aware of the behavior of others. This perceptual tendency or bias to attend to the behavior of conspecifics (and non-conspecific others like ourselves) provides a vital cognitive interface for coordinating social interaction, regulating purposeful group activities important for survival (e.g., hunting) and maintenance of the group (e.g., reproduction), and for modulating social contagions conducive to unified group actions appropriate to the changing environmental circumstances operating on the group—ranging from the calming yawn and sleep to the alarm bark stimulating enhanced group arousal in preparation for effective social defense.

Although there can be little doubt that a dog's social tendency to attend to the activity of others contributes to what it does and broadly limits what it is likely to learn (an inclination reflected in a dog's willingness to accept obedience training and perform reliable services), the question of how these social influences affect learning by contact, coaction, and observation is a conceptual minefield, containing numerous pitfalls that require careful observance of subtle detail and logical distinctions if one is to navigate safely around them. This is especially the case with the question of observational learning. Indeed, before commenting on whether or not a dog learns via observation or imitation, it would seem advisable first to describe three other closely related behavioral phenomena, all of which have been confounded with observational learning in the dog behavior literature and elsewhere. These imitation-like phenomena include allelomimetic behavior, social facilitation, and local enhancement.

Allelomimetic Behavior

Allelomimetic or group-coordinated behavior depends on an innate social inclination to follow the lead of conspecifics and do the same thing, appearing to adjust to the locomotor pace and motivational intention of the other in the process. Puppies show signs of allelomimetic behavior from an early age onward, and many socially significant behaviors are learned as a secondary result of socially coordinated behavior. For example, coming when called is easily encouraged by having a puppy chase after the handler as the latter runs away and rewarding the puppy for following along. Similarly, walking along close at the handler's side is an allelomimetic tendency that can be rapidly shaped and brought under stimulus control, especially if the puppy is provided numerous walks early on that include appropriate reinforcement of such heeling behavior whenever it occurs.

Social Facilitation

A related concept in animal behavior is social facilitation. Scott (1968) carefully distinguishes allelomimesis from social facilitation, noting that the former is a purely descriptive

term, whereas the latter refers to the potentiating effect that one animal has on the behavior of another. Although allelomimetic behavior is responsive to social facilitation, the terms are not the same and should not be confused with each other. In fact, social facilitation affects both allelomimetic and non-allelomimetic behavior. To emphasize this important distinction, Zajonc (1965) divided social facilitation into two general subtypes—coactive effects and audience effects—depending on whether the facilitator is performing the same behavior or is merely present in the situation.

Coactive social facilitation is observed in dogs doing something together, such as running, barking, greeting a guest, or defending against an intruder. When coactively engaged in some activity, they may reciprocally stimulate one another to run faster or bark louder than they might otherwise if alone. Many common examples of coactive effect can be observed (e.g., fence running). Similarly, two dogs fed together will usually eat more and eat faster than if fed apart. Social facilitation is something that many of us are likely to experience (and suffer) over holidays as we feast and wax merry with friends and family!

Social facilitation does not necessarily require that the other animal actually participate in the facilitated behavior. For example, the mere presence of a nearby dog will typically cause a dog that is eating to eat more rapidly or to eat even when it is no longer hungry. The facilitator need only be present as an "audience" to stimulate or enhance the other dog's eating behavior. These effects are common among humans, as well. Consider, for example, the effects of cheering fans on the behavior of athletes at a sporting event or even the gaping and awing of bystanders observing a street brawl (or dog fight, for that matter).

The potentiating effects of social facilitation appear to result from a state of generalized arousal (*nonspecific drive*) stimulated by the presence of another animal. This arousal tends to increase the magnitude of whatever the animal happens to be doing, especially if the ongoing behavior is well learned or motivationally dominant at the moment (e.g., eating, greeting, running, barking, or threatening).

Although social facilitation is often beneficial and desirable for enhancing performance [e.g., a sled dog's performance is enhanced (facilitated) by the presence of other dogs pulling in the same direction], it may interfere with learning new behavior, especially the acquisition of arbitrary or complex skills that require steady concentration to learn. In such cases, the effect of others is referred to as *social interference.* For example, the presence of other puppies playing nearby is apt to interfere with an observing puppy's ability to hold a sit-stay for long before breaking off and joining the fun. Such interference effects are a common obstacle in the process of modifying unwanted behavior in a home containing more than one dog.

Local Enhancement

Local enhancement is a special form of social facilitation that is sometimes interpreted as evidence of observational learning (Thorpe, 1956). Local enhancement appears to include aspects of allelomimesis, social facilitation, and trial-and-error learning. The term, however, specifically refers to the tendency of animals to orient and attend to the same environmental cues and stimuli as others with which they are interacting. This coordinated tendency to attend to the same environmental stimuli encourages them to behave in similar ways. For example, one dog may draw the attention of another to a hole in the fence by going through it, thus causing the other to approach the spot and quickly escape in a similar way without needing to search for a way out. Teaching a dog to hop into a car may be enhanced by allowing a more experienced dog to jump in first, followed by the less experienced dog. It is likely that the inexperienced dog will learn the action much more rapidly than if he had to figure it out by himself.

Learning by Observation: Myth or Fact?

Although the coordinating effects of allelomimesis, social facilitation, and local en-

hancement on learning often look like observational (i.e., imitative) learning or copying, they are not, at least, insofar as observational learning is defined by experimentalists working with such problems. Observational learning is operationally defined and limited by constraints that exclude these social learning phenomena. Typically, such experiments include a demonstrator in one compartment and an observer looking on from a similar adjacent compartment. An arbitrary behavior is selected by the experimenter that is learned through trial and error by the demonstrator. The test phase involves measuring and comparing differences in the rate of acquisition exhibited by observers versus nonobserver controls when presented with the same problem previously solved by the demonstrator.

Early efforts to quantify observational learning in dogs were carried out by Thorndike, who performed a number of studies but was unable to show evidence of observational learning in the dog, leading him to conclude,

> It seems sure from these experiments that the animals were unable to form an association leading to an act from having seen the other animal, or animals, perform the act in a certain situation. Thus we have further restricted the association process. Not only do animals not have associations accompanied, more or less permeated and altered by inference and judgment; they do not have associations of the sort which may be acquired from other animals by imitation. What this implies concerning the actual mental content accompanying their acts will be seen later on. It also seems sure that we should give up imitation as an *a priori* explanation of any novel intelligent performance. To say that a dog who opens a gate, for instance, need not have reasoned it out *if he had seen another dog do the same thing,* is to offer, instead of one false explanation, another equally false. Imitation in any form is too doubtful a factor to be presupposed without evidence. (1911/1965:95)

Thorndike's assessment all but closed the book on observational learning in dogs. This effect still echoes today, with remarks like those by Reid on the topic being fairly typical. Prefaced by an interesting flyball experiment for falsifying the notion of observational learning, she writes,

> Having described that hypothetical experiment, let me conclude by saying there is virtually no evidence that animals, except for humans and the great apes (gorillas, orangutans, and chimpanzees), are capable of pure imitation. Some researchers have devoted their entire professional lives to devising ways to demonstrate imitation, without success. Sorry to rain on your parade, but dogs just don't seem to be able to manage learning by imitation. (1996:169)

This statement is overly strong and not consistent with the available scientific evidence regarding observational learning in animals (see Vauclair, 1996). Observational learning has been demonstrated in many species other than the great apes, including a variety of birds, rodents, dolphins, and dogs (at least young dogs). Several studies have demonstrated evidence of observational learning in rats (Heyes and Dawson, 1990; Heyes et al., 1994).

Pryor (1975) reported an interesting example of observational learning in a pair of porpoises she had trained as part of her famous "creativity" study (Pryor et al., 1969). The two animals had worked in close proximity with each other but had learned separate routines. The performance followed a set order with one porpoise regularly preceding the other. When not performing, the remaining porpoise was restrained in a separate gated area from where it could look on and observe its cohort. One day during an actual performance, the two porpoises appeared unusually nervous and their performances were somewhat awkward, disorderly, and strained; nonetheless, each performed the behaviors required sufficiently well to not raise suspicion about what had happened. It was not until after the show was over, and the audience was beginning to leave, that the trainer realized the cause of the problem: the two animals had been mistakenly switched and put in the wrong holding tanks. The remarkable result was that each had performed the repertoire of the other. Apparently, working closely together over the preceding several months, each had learned the routine of the other,

even though they had not received any explicit training to do so.

Observational learning is also apparently operative in young dogs. Adler and Adler (1977), for example, have shown that such abilities (i.e., response learning without direct reinforcement) are exhibited by puppies. The experiment employed was of a very simple and straightforward design. Observers were permitted to watch demonstrators learn by trial and error to secure a ribbon and pull a small cart with food on top of it into their cages. After five sessions, the observers were given access to the ribbon and timed. Significant benefit accrued to the observers, especially when comparing first-trial results. At 38 days of age, demonstrators took 697 seconds compared with observers, who solved the problem in 9 seconds. At 60 days, demonstrators took 595 seconds, with observers requiring only 40 seconds. These studies indicate several operative cognitive implications that extend well beyond simple S-R learning, including the ability to learn by observation and imitation. More recently, Slabbert and Rasa (1997) gathered fairly strong evidence indicating that dogs might benefit from observational learning. They found that when puppies between 9 and 12 weeks of age were permitted to observe their narcotic-detecting mothers search for hidden sachets containing narcotics, they generally proved more capable of learning the task at 6 months of age than controls not permitted to observe their mothers at work.

Observational learning remains a controversial topic. Further, before any blanket statements can be safely made about whether dogs learn via observation or not, there remains much to be studied in the area of animal cognition and learning. Although puppies clearly appear to learn through observation, the existence of observational learning in adult dogs remains in doubt, at least until more conclusive research is available. No experiment to date (that I know of) demonstrates observational learning in adult dogs.

Higher-Order Classes of Behavior

The simple instrumental paradigm of learning discussed above is frequently insufficient in terms of explanatory value and practical control when applied to complex naturalistic situations. Estes drew attention to the important role of higher-order routines and classes of behavior in an effort to account for such problems with reinforcement theory. He notes that "the frequency with which animals and men in nonlaboratory situations repeat punished acts and fail to repeat rewarded ones is so great that, as a statistical generalization, the empirical law of effect is all but vacuous" (1971:26). Estes's observation does not imply that reinforcing and punitive events are without effect on behavior, but that the effects of such events appear to be vitiated by interference stemming from the collective influence of the higher-order class of behavior to which the response belongs. That is, the higher-order class of behavior may compete with the contingencies of reinforcement controlling specific instances belonging to it, sometimes rendering them, in the words of Catania, "insensitive to the contingencies arranged for them" (1992:377).

There are many examples of higher-order behavior exhibited by dogs, for example, attention seeking, fear-related behavior, dominance-related behavior, play, and attachment behavior. A couple of examples should help to illustrate and clarify the importance of higher-order classes in routine behavior modification. Many persistent behavior problems are driven by higher-order affiliations. For example, although extinction may be an effective procedure for the reduction of some excessive behaviors, it is rarely effective for attention-seeking behaviors like jumping up. Ignoring the jumper infrequently helps to reduce the frequency of the habit. Even when punishment is applied (e.g., time-out), the habit can be surprisingly persistent. One reason for this failure of extinction is that the higher-order class of *attention-seeking* is main-

tained by the reinforcement of other attention-seeking behaviors belonging that class. Another example of some practical significance is dominance-related behavior, especially involving aggression exhibited toward the owner. Despite the most conscientious efforts to suppress aggressive displays, unless all instances of competitive behavior are simultaneously treated as a group, such efforts will not yield much lasting benefit. According to Catania, "When a class of responses seems insensitive to its consequences, ... we must entertain the possibility that we have improperly identified the class and that it is part of a larger class the members of which continue to have their former consequences" (1995:196).

These general relationships between higher-order classes and subclasses have been examined in terms of expectancy theory. Rotter (1975) has divided expectations of reinforcement into two forms of expectancy: specific and generalized. *Specific expectancies* refer to a simple contingency between an emitted behavior and an associated reinforcing event. *Generalized expectancies*, on the other hand, develop as the result of a functional similarity between situations that typically result in reinforcement. Generalized expectancies are very similar in effect to learning sets or the process of "learning how to learn." Dogs exposed to previous training tend to generalize expectations from past successes or failures to current training demands. Consequently, specific and generalized expectancies form complex and dynamic interdependent relationships influencing both trainability and performance. Although generalized expectancies profoundly affect new learning situations, with repeated exposure generalized expectancies are typically weakened while specific expectancies based on experience with the training situation are strengthened. Returning to the previous example of jumping up, the jumper learns after repeated corrections or time-outs that the generalized expectancy is now being disconfirmed with regard to the higher-order class (attention-seeking) operative in this specific case (jumping up). As a result, jumping is weakened, thus making the reinforcement of some other behavior incompatible with jumping up possible.

Attention and Learning

A dog's ability to concentrate selectively on specific aspects of the environment and to exclude others is a faculty of tremendous importance for effective dog training and behavior modification. Historically, the study of attention was neglected due to a widely held belief that the scientific investigation of behavior ought to be restricted to the study of measurable units resulting from the interaction of external events (i.e., stimuli and responses). This general doctrine known as *radical behaviorism* rejected cognitive phenomena like *attention* as inaccessible and irrelevant to a scientific understanding of animal behavior. Radical behaviorists also rejected explanations that employed physiological hypotheses and constructs.

The artificial dissection of behavior from its cognitive and physiological underpinnings was an unfortunate stratagem—one that logically precluded from the outset the possibility of a complete and holistic theory of behavior and learning. Interestingly, though, in spite of the outward rejection of attention as a worthy subject of scientific psychology, the radical behavioristic tradition has indirectly provided a rich and useful foundation and methodology for its investigation by contemporary cognitive psychologists (Cohen and O'Donnell, 1993). It should be stressed, however, that not all learning theorists historically rejected attention as a subject for study. Thorndike, for example, posited a subordinate law that he called the *prepotency of elements* in which certain features of the environment are selectively attended to by an animal on the basis of their prepotency or usefulness for solving a problem. Also, many modern learning theorists have contributed significantly to the study of attention; espe-

cially relevant here is the work of Rescorla, Kamin, and Macintosh (Hall, 1991). In addition, the dogmatic viewpoint regarding attentional behavior has yielded to some thoughtful revisions in recent textbooks covering the topic of attention and attending behavior (Schwartz, 1989; Catania, 1992; Lieberman, 1993).

Attention is perhaps the most basic class of behavior in which both classical and instrumental elements closely cooperate in the mediation of effective perception and action. What a dog pays attention to from moment to moment involves the participation of a complex cognitive gateway or interfacing mechanism processing information from within the animal (e.g., motivational states) and coordinating it with events and opportunities occurring outside of the animal within the changing circumstances of the environment. This cognitive gateway is regulated by a variety of motivational, perceptual, and motor components in constant interaction. In a broad sense, attentional activities specify a dog's intentions, reveal a dog's motivational state, and to some extent define what a dog is prepared to learn—that is, attentional activities reflect a dog's overall disposition to learn.

At the most basic level, all learning requires that an animal exhibit an active attention toward the training situation. As noted in the previous chapter, surprising or startling reinforcers produce the strongest effect on behavior. Such events also evoke the keenest interest and attentional focus—that is, startle and surprise serve to emotionally mediate and potentiate attentional behavior. Lieberman (1993) has called such events *markers*, suggesting that surprising/startling events produce dramatic effects on learning. Stimuli that lack surprising or startling qualities tend to drift into the background, become progressively irrelevant, and are eventually ignored. In the case of classical conditioning, conditioned stimulus (CS) salience or interest depends on its predicting some element of surprise. Once a CS exactly predicts the extent of the unconditioned stimulus (US), interest in the CS as a source of information gradually diminishes. This does not mean that the CS is considered to be *irrelevant* (irrelevance occurs when the CS occurs independently of the US), but that it is no longer actively followed or paid much attention to because there is not much more to be learned from its occurrence. Instead of actively attending to the CS, such well-conditioned stimuli are responded to in a progressively mechanical and automatic way. However, if suddenly a larger-than-expected US (e.g., consider the case of a bonus or jackpot) occurs in the presence of the diminished CS (e.g., "Good"), then new interest and attention will be generated by the future presentation of the conditioned reinforcer "Good."

Besides facilitating classical conditioning, markers also appear to play a very significant role in instrumental learning. Surprising events potentiate learning abilities, even promoting learning occurring under adverse conditions. As has been previously discussed, any delay of reinforcement usually has a deleterious effect on learning. However, Lieberman and his associates (1979) studied various situations in which these adverse effects could be overcome by utilizing a *marking* event. For example, they placed rats in a T maze where a food reward was delivered after a minute delay, provided that the rat chose the right arm of the maze. If the rat chose the left arm instead, no reward was delivered. The rats, as one might predict, failed to learn the correct response required to obtain the belated reward. However, the experimenters found that if the subjects were picked up immediately after they made their choice (whether correct or wrong) and were then placed back into the maze to complete their chosen route, the handled subjects learned the correct route much more effectively than nonhandled controls. During testing, the handled rats chose the correct arm in 90% of the trials, whereas the controls were only correct 50% (chance) of the time. Similar effects were observed in the case of other surprising/startling stimuli (e.g., light or noise) that were presented immediately after the rat's choice (correct or wrong) was made. Again, the food reward associated with the correct choice was always delayed. Lieberman and colleagues speculate that markers enhance the functioning of attentional processes and memory coding of

relevant cues, with the marker evoking extra attention to events occurring immediately prior to its presentation. The overall effect is to make *marked* events more likely to be remembered and associated with remote outcomes, such as the delay of reinforcement as in the foregoing experiment.

Obviously, stimulating and controlling attentional behavior is of considerable interest to the trainer/behaviorist. Dogs pay attention to occurrences that are significant to them and learn to ignore occurrences that are irrelevant. Stimuli that have been associated with hedonically significant events or fear tend to attract more attention than neutral stimuli not having undergone such conditioning. In addition, previously conditioned stimuli tend to overshadow neutral stimuli occurring coincidentally in the training situation, thus blocking an associative connection from developing between them and the relevant US—a classical conditioning process that has been investigated in detail by Kamin (1968). Those elements of the environment that do not hold a dog's active attention are of little significance to the learning process. In short, selective attention allows dogs to focus on relevant stimuli while ignoring irrelevant occurrences competing for their attention. Without this ability to attend selectively to environmental events, dogs would not only be unable to learn, they would be thoroughly incapacitated by a disorganized influx of chaotic stimulation. Clearly, attention plays a very significant role here in terms of transforming raw experience into informative input about the environment.

Since attention is highly correlated with reinforcement (both positive and negative), it follows that animals should become more attentive with experience. This analysis implies that reinforcement of attention in one situation should improve attending behavior in other more remote training situations. Attending behavior may be reasonably interpreted, therefore, as a higher-order class of behavior that contains a large subclass of behaviors in which attention plays an instrumental role. In addition, since attending behavior is present in most successful learning situations, it may be considered the most *dominant* class of higher-order behavior, under which all other classes of instrumental behavior are subsumed according to their relative frequency and probability. According to this line of analysis, the most likely behavior in any given learning situation is an attentional orientation (physical and perceptual) toward significant training stimuli. It is astonishing to consider that the most dominant class of instrumental behavior—attending—has been the least carefully studied.

The sort of stimuli that attracts a dog's attention frequently reveals an underlying biological significance and purpose being served by them as well as past learning. Many of these stimuli and events naturally attract and hold a dog's attention even prior to learning. For example, the vaginal discharge produced by an estrous female attracts the intense attention of an intact male even before his first sexual experience. The discharge contains pheromones (i.e., chemical signals) that trigger or mediate interest via olfactory stimulation of appropriate brain centers controlling sexual activity. These *hardwired* connections are established prior to actual sexual contact with a receptive female. A dog's sensory faculties also predispose it to react to certain stimuli in a relatively fixed manner. Visual cliff-avoidance reactions can be observed in young puppies (reliably after 28 days of age) prior to their experiencing any actual falls. Also, loud noises elicit intense startle reactions as soon as the ear canals open at about 3 weeks of age. The startle reaction to noise occurs without actually having been associated with previous aversive stimulation. Some sensory stimuli are attended to more keenly than others. Clearly, while color perception is of some usefulness to dogs, they are more apt to attend visually to movement, shapes, and shades of gray than to discriminate objects based on their color. Also, dogs appear to select certain classes of stimuli preferentially over others as cues when learning discrimination tasks. For example, Lawicka's (1964) discrimination studies have demonstrated that dogs prefer spatially lateralized discriminative stimuli or cues when learning a directional task and qualitatively differentiated cues (different tone frequencies) when learn-

ing go/no go discriminations. Also, McConnell (1990) has reported that dogs selectively respond to auditory stimulation depending on its characteristics. Her studies suggest that active behaviors such as coming when called may be more easily associated with signals composed of rapidly repeated sounds (e.g., hand claps and smooches), whereas staying in place may be more easily obtained with continuous, drawn-out signals (see Chapter 5).

Another important influence on a dog's attending behavior is the dog's changing motivational state. Motivation has a pronounced influence on the class of stimuli that will attract and maintain a dog's attention. Hungry dogs are especially attracted to odors and conditioned stimuli that have been associated with food in the past. Highly social or socially deprived dogs will likely search the environment for opportunities to make contact with other dogs or people. Aggressive dogs scan the environment for evidence of people or other dogs that they might challenge or attack. Fearful dogs often engage in hypervigilant searching behavior in an effort to identify and avoid potential threats.

A Brief Critique of Traditional Learning Theory

The principles of learning theory have been derived from the experimental study of behavior. This research has been based on a small set of empirical assumptions and beliefs. Perhaps the most central and pervasive of them is the *law of effect,* that is, behavior is modified by its consequences. If a behavior is rendered more likely to occur in the future as the result of its consequences, it is said to have undergone reinforcement. Reinforcement is divided into two categories depending on whether the behavior involved produces the reinforcer (positive reinforcement) or avoids/terminates the reinforcing event (negative reinforcement). The theory also posits punishment as producing an effect opposite to that of reinforcement. When an anticipated positive reinforcer is omitted, the effect is negative punishment (P–). Conversely, when a negative reinforcer is presented positive punishment occurs (P+). In both cases, punishment is defined as an event that lowers the future probability of the punished behavior. The term *punishment* is also used more generally to designate any outcome that suppresses behavior—regardless of the target behavior's reinforcement history.

This general system of analysis has been extremely productive. Many thousands of studies have been performed ostensibly confirming these basic assumptions and postulates. Further, there is also little doubt that the paradigm works as a practical system for the control and modification of behavior. Despite such heuristic and practical value, however, these most fundamental assumptions are vulnerable to theoretical criticism, especially with regard to issues involving parsimony and logical coherence (i.e., how the theory relates to behavior).

Reinforcement and the Notion of Probability

The *notion of probability* is central to the traditional behavior analytical interpretation of reinforcement (Johnson and Morris, 1987; Catania, 1992). Despite the central importance of "probability" in science, and, in particular, behavior analysis, it has not received a great deal of independent attention. Curiously, in Murray Sidman's important book (the "Bible" of many experimental behavior analysts) *Tactics of Scientific Research: Evaluating Experimental Data in Psychology* (1960), *probability* as a scientific concept is left to the reader's imagination. This lack of analysis is especially surprising and troubling considering the generally vague meaning of the term *probability* in science. These various shortcomings appear to have prompted Bertrand Russell to sardonically comment: "Probability is the most important concept in modern science, especially as nobody has the slightest notion what it means" (quoted in Johnson and Morris, 1987:107).

Nonetheless, reinforcement is defined (as has been frequently reiterated above) in terms of the effect it has on the future *probability* or *frequency* of the reinforced behavior. *Response probability* is typically defined as a proportional relation between the number of opportunities for the response to occur and the number of times it actually occurs. For example, if a dog is signaled to sit 15 times but only sits on 9 of those occasions, the probability that he will sit on signal is 0.6 (calculated by dividing 9 by 15).

However, with this definition of response probability in mind, how can one determine whether a given response has undergone reinforcement, unless one knows in advance the effect of reinforcement. Let us say, for example, that a dog were to receive a reinforcer as the result of sitting on a single occasion, can an objective observer really make any predictions from that one event about the future probability of the sit response? How about after two, three, four, or five reinforcements? In fact, nothing very definite can be said about the response's future probability after a single exposure to reinforcement. Consequently, since it is not possible to calculate probabilities from the first reinforcing event onward, how can one say of these early events whether they were reinforcing? Obviously, it is only after the habit of sitting becomes highly predictable and regular that one might infer (or speculate?) that the sit response had undergone previous reinforcement.

Another problematical area regarding response probability as the defining characteristic of reinforcement is observed in cases where no additional improvement in response probability is evident as the result of continued reinforcement. Take, for example, a dog that has undergone several hundred trials of training, until the dog has achieved an almost errorless proficiency or fluency at sitting on signal. Reinforcement in this case may have some effect on the behavior of sitting, but, assuming that the sit response's probability of occurrence cannot be *measurably* improved upon, in what sense can one say that the behavior is reinforced? If the behavior's probability cannot be improved upon (or worsened) through reinforcement, then what is the event to be called? (By the way, I have chosen the term *verifier* for such instances; see Chapter 8 for a more detailed discussion). In conclusion, it appears that the probability theory of reinforcement breaks down in cases involving single and many (asymptotic) reinforcing events.

The probability account of reinforcement also appears to break down in the case of shaping (Catania, 1992). During shaping procedures, no particular response is repeated in exactly the same way. Behavior operating under a shaping contingency is emitted with a high degree of variability, with differential consequences gradually narrowing instrumental efforts to progressively approximate the target response—a process in which response probability (e.g., frequency or rate) is rather irrelevant. It is evident during the shaping process that the dog optimizes its chances of obtaining the offered reinforcer by changing its behavior along several dimensions at once. In general, the dog becomes more active and exploratory, especially if it is hungry. When, as the result of discovering that some behavioral change improves its control over the reinforcer, the dog's effort in that direction is intensified.

Efforts to analyze the relationship between reinforcement and response probability in terms of the foregoing definition (i.e., reinforcement increases the future probability/frequency of the behavior it follows) are dependent on the size of the response/reinforcer sample being observed. The belief that response probability is improved as the result of reinforcement is an uncertain assumption in the case of small samples, but one that becomes progressively more certain (to a point) as the sample size increases. The assumed overall effect of reinforcement on response probability does not appear to be measurable on the level of individual responses and reinforcing events. If it is not measurable at the level of individual responses and reinforcing events, can one be sure that the effect is not a statistical myth?

Probability appears to be evident only in cases where patterns and molar relations

(classes of behavior) are studied as the basic unit of analysis. Furthermore, the usual definition of reinforcement in terms of increasing response probability only begs the question about the effect that reinforcement has on discrete units of behavior—it says nothing about how or why increased predictability and regularity result from reinforcement. The usual definition only asserts that the response's increased predictability and regularity (as a function of probability) is predicated upon reinforcement. One might conclude that the relationship between reinforcement and response probability as it is characterized by behavior analysis is a post hoc interpretation of reinforcement—certainly not a causal account of how reinforcement affects the probability/frequency of behavior. Perhaps the strongest statement that can be made about the relationship between reinforcement and response probability is that the two are correlated—that is, reinforcement is positively correlated with an increased response probability/frequency.

A variety of experimental and conceptual considerations led Johnson and Morris to question the value of probability theory in the analysis of behavior: "If the concept of probability does not enhance the description, prediction, and control of behavior, then perhaps its role in behavior analysis should be re-evaluated" (1987:124). An alternative discussed by them is to replace the notion of probability with that of *propensity*, which is defined in terms of the experimental arrangement or context in which behavior occurs:

> "Propensity," then, makes clear the importance of context in affecting the outcomes that probabilities are taken to predict, whether of the behavior of coin tosses or organisms. With respect to the behavior of coins, for example, a biased coin will produce different outcomes depending on the strength of the gravitational field in which it is tossed. In a weak gravitational field, the bias will have little effect; in a strong gravitational field, the bias will be enhanced. Likewise, with respect to the behavior of organisms, a propensity interpretation emphasizes the contextual nature of behavior and takes probability to be a characteristic of the experimental arrangement as a whole, not just a property of a sequence of events without reference to other conditions. (1987:124–125)

Positive and Negative Reinforcement and Ockham's Razor

The term *reinforcement* is further complicated by its division into positive and negative categories. On many levels, these distinctions appear arbitrary and confusing (Michael, 1975; Iwata, 1987). Positive reinforcement is distinguished from negative reinforcement by the manner in which the reinforcing event is operated upon by the animal. In the case of positive reinforcement the animal's behavior is reinforced by producing the presentation of an event, whereas in negative reinforcement the animal's behavior is reinforced by either terminating or avoiding the presentation of an event. In a certain sense, all instrumental learning can be reduced to one or the other of these categories. It simply depends on how the events are viewed and interpreted. An animal escaping and subsequently learning to avoid aversive stimulation may not in the first place "view" his success as escape-avoidance but, instead, frame the learning situation in terms of the acquisition of safety (a positive reinforcer) from aversive stimulation. Thus, under similar future circumstances of impending threat, the animal will likely select the successful behavior resulting in the acquisition of safety and relief in the past. Conversely, an animal that is deprived of free access to food and starved to 80% of its ad lib feeding weight may find the general physiological state aroused by deprivation aversive and attempt to terminate or avoid it by performing various arbitrary behaviors (e.g., key peck) to obtain food. Thus, from this perspective, working for food may be interpreted as escape-avoidance behavior aimed at reducing or terminating the aversive condition of starvation. Unfortunately, the terms positive reinforcement and negative reinforcement—although of some practical value in the everyday control of behavior—are highly subjective and appear to depend on an experimenter's point of view and bias.

In an important sense, the bifurcation of reinforcement into positive and negative categories is a rather unfortunate violation of Ockham's razor: *Entia non sunt multiplicanda praeter necessitatem* ("Entities are not to be multiplied beyond necessity"). Whether an animal's behavior produces or terminates/avoids the reinforcing event, the bottom line is that reinforcement is contingent on the successful prediction and control of significant impinging events. Whether these events are appetitive, sexual, social, agonistic, playful, or aversive is of only secondary interest. Regardless of an animal's disposition to learn, the goal of purposive behavior is to predict and control outcomes. Locating food when hungry and finding a successful route of escape when threatened are behaviors that are both strongly reinforced in the same general way. The reinforcement of such behavior does not depend on a hypothetical enhancement of probability but on the more immediate and real outcome of having successfully exercised decisive control over the occurrence of such events (i.e., finding food when hungry and locating a route of escape when threatened). Essentially, reinforcement occurs when an animal successfully controls any event in such a way that the animal's self-interests are served (survival) and its well-being enhanced.

An Alternative Theory of Reinforcement

According to the foregoing line of reasoning, instrumental reinforcement occurs when any behavior successfully controls a significant event or situation impinging on an animal. In other words, reinforcement does not stand apart from the reinforced behavior. In the case of classical conditioning, reinforcement occurs when a significant event is adequately predicted by anticipatory stimuli associated with its occurrence. Functionally speaking, sharp lines of distinction between instrumental and classical phenomena do not exist except under the artificial conditions of the laboratory and not really there either. The synthetic relationship and interdependency existing between these two classes of behavior (instrumental and classical) results in the necessary conclusion that perhaps only one general form of reinforcement exists for both paradigms. *Successful control depends on adequate prediction and adequate prediction depends on successful control.* When significant events are adequately predicted and controlled, the consequence is adaptive success—an enhanced state of well-being, confidence, and power.

Within this general framework, the biological and motivational inclinations driving behavior (e.g., hunger, fear, and other homeostatic needs) together with past learning experiences form an animal's *disposition to learn.* The disposition to learn can be fairly characterized by the sort of environmental events the animal seeks to predict or control, that is, events that the animal treats as significant. For instance, the presentation of food to a hungry dog has a far greater significance to that dog than to another dog that is satiated. In the case of learning to sit, the disposition to learn is characterized by a dog's effort to control several basic needs, including contact (affection), food (appetitive), and, perhaps, the escape-avoidance of aversive stimulation (fear). The need to predict and control the environment is directly related to the maintenance of biological, emotional, and psychological homeostasis and security. The overall goals of the disposition to learn are survival, adaptive success, enhanced power, and, ultimately, reproduction.

In any instrumental learning situation, at least three basic elements interact with one another: a signal (S), a response (R), and an outcome (O). The primary function of the S is to announce a moment when a particular behavior will most likely result in reinforcement. However, the S is much more complicated than this simple description indicates. In addition to announcing the moment and the sort of behavior most likely to result in reinforcement, the S also makes other predictions. One such prediction concerns the type (quality) and size (quantity) of the probable reinforcer available. This prediction has a pronounced effect on how the response will be affected by reinforcement. Three general

variations are possible, depending on the kind of prediction involved: (1) The S underpredicts the type or size of the reinforcer (acquisition). (2) The S overpredicts the type or size of the reinforcer (extinction). (3) The S exactly predicts (verifies) the type or size of the reinforcer (maintenance).

Relations Between the Signal, Response, and Outcome

On a basic level, most behavioral and training events are organized and structured in terms of triads. The most obvious triadic structure is composed of the signal (S), response (R), and outcome (O). Each element in this triadic compound depends on and influences the others, forming several binary relations. These several interdependent binary relations between S, R, and O provide a great deal of information to dogs (Rescorla, 1987). For example, S (cue or command) tells dogs what to do (S-R) as well as designating the contingent outcome available (S-O), provided that it responds. Several other relations between S, R, and O become progressively apparent as the response is repeated in the presence of the predictive signal and the confirming occurrence of the predicted outcome during the course of training. These intertrial effects are influenced by the repetitive occurrence of the basic pattern. For example, O confirms the prediction S (R-O) while simultaneously designating the end of the trial and the possibility of another. Thus, O has a link with S as part of a general confirming relation (O-S)—that is, the outcome confirms the predictions of S, concludes the trial, and signals the possibility of a new one. The outcome of the preceding trial also affects R of the succeeding trial by making it more or less likely to the extent that the previous emission of R confirmed or disconfirmed the predictions made by S. These intertrial relations and effects extending from trial to trial are summarized thus:

1. S (R-O) produces the predictive binary relations S-R and S-O, such that O will occur, if and only if R occurs in the presence of S.
2. O (S-R) produces the confirming binary relations O-S and O-R, such that R will be more likely, if and only if S adequately predicts the presentation of O given that R occurs. Conversely, if the prediction of O given S and R is disconfirmed (e.g., reinforcement is omitted), then R will become less likely in the future.

Finally, R is also connected to S and O in terms of the control R exercises over the presentation of the predictive signal and outcome. Under circumstances of repeated practice, a dog gradually learns that R controls the reoccurrence of the predictive signal and outcome or R (S-O). This last set of relations summarizes the operative or controlling effect that the dog's behavior has on the handler's behavior. In an important sense, the handler's training behavior is controlled by the dog's recognition (as evident in his behavior) of a contingent relation between its behavior and the presentation of the predictive signals and confirming outcomes controlled by its behavior. From the handler's point of view, the dog is successfully controlled by the presentation of the predictive signals and the confirming outcomes. In other words,

3. Provided that the predictive relations S (R-O) are confirmed by O (S-R), then R (S-O) produces the operative or controlling binary relations R-S and R-O, such that R sets the occasion for the presentation of the predictive S (R-O) contingency, producing the opportunity for R to produce O again, thus further strengthening R while reinforcing the entire chain of events.

In summary, the interdependent relations produced by repeated reinforcement include prediction, confirmation, and control:

1. S(R-O): A predictive relation between the signal and the response (S-R) and the signal and the outcome (S-O).
2. O(S-R): A confirmative relation between the predicted outcome and the signal (O-S) and the predicted outcome and the mediating response (O-R).
3. R(S-O): The operative relation between

the controlling response and the repeated confirmation of the predictive signal (R-S) and the predicted outcome (R-O).

Besides the foregoing functions, the S also formulates predictions about the ability of the target behavior to control available outcomes. Outcome control is operationally defined in terms of the dog's relative ability to predict and control significant outcomes (see Fig. 9.3).

The prediction and control of significant events result in the formation of various expectancies regarding the effectiveness of behavior to anticipate and control such events in the future. These expectancies or instrumental cognitive sets are derived from past learning experiences and are of great importance for both facilitating or retarding learning. An expectancy is confirmed or disconfirmed by the degree of correspondence between what the animal expects to occur and what actually occurs. A high degree of correspondence results in confirmation, whereas a low degree of correspondence results in disconfirmation. For example, if a dog expects to be reinforced each time it sits, but on some occasion it is not reinforced (i.e., the dog is *disappointed*), the generalized expectancy that sitting always results in reinforcement is disconfirmed. The disconfirmation of a generalized expectancy results in its revision into a *probable* or statistical expectancy—that is, the dog no longer expects to be reinforced each time it sits. Similarly, if a dog has never been reinforced as the result of sitting but happens to receive a treat on some occasion after sitting, the novel reinforcing event disconfirms the previously held expectancy that sitting is not followed by the presentation of food. In the future, the dog may now anticipate or *hope* for the presentation of food when it sits.

The revision of expectancies occurs in order to secure a more perfect match between past experience and current reinforcement contingencies, thus continuously refining and adjusting an animal's ability to predict and control significant events occurring within the flux impinging upon it. In an important sense, the cognitive function of expectancy is the exercise of a reality principle, establishing an informative feedback loop between the animal's past experiences with current sensory and behavioral efforts to predict and control the occurrence of significant events. The most dramatic examples of *dissonance* occur in cases in which highly regular and generalized expectancies are disconfirmed. The least dramatic change or dissonance occurs in cases where the disconfirmation is statistically significant but remains consistent with the animal's overall expectations. For example, a dog that is accustomed to receiving reinforcement after sitting two or three times will notice, and adjust accordingly, when it is instead reinforced only on every fifth or sixth occasion. The change in this case would be merely statistical and not nearly as dramatic as the resultant dissonance would be if the dog were all of a sudden punished each time it sat, for example.

Punishment

What is the relationship between reinforcement and punishment? Traditionally, behavior analysis defines punishment in terms of the effect an event has on behavior insofar as its presentation (positive punishment) or omission (negative punishment) suppresses or lowers the future probability/frequency of the behavior it follows. However, defining punishment as a suppressive event is to describe it in terms of its most superficial and general attributes. As it stands, this definition of punishment might be construed to include events that are clearly not intended as punishment. For example, when dogs are reinforced with food, other possible behaviors, except those directly facilitating access to food and eating, are suppressed and made less likely to occur in the future by the reinforcer's presentation. Similarly, aversive stimulation suppresses all concurrent behavior at the moment except the response that results in the termination of aversive stimulation.

An alternative definition of punishment may be stated in terms of prediction and control. According to this interpretation, punishment is defined as occurring whenever a behavior fails to anticipate and control a

significant event adequately. Punishment is not something done to a behavior or to an animal but rather something that the behavior itself does or fails to do—that is, it fails to appropriate an important resource or escape or avoid an aversive or dangerous situation. The cause of this failure can be causally traced to any number of factors. Instrumental punishment often results when stimulus events are inadequately predicted or when correct predictions are not followed into effective action. For example, if a hungry dog fails to obtain a piece of food for sitting because it misses a signal or fails to sit in a timely fashion, the dog is punished—not indirectly as the result of the withdrawal of the appetitive opportunity—but directly as the result of its failure to control the opportunity to obtain food. Conversely, if the same dog fails to terminate or avoid an aversive event by sitting because it misses a signal or fails to sit in a timely fashion, the dog is punished—not indirectly as the result of the presentation of the aversive event—but directly as a result of its failure to control the presentation of the aversive event.

Punishment is associated with the elicitation of various concomitant emotional states, especially fear and frustration. Punishment resulting from a failure to predict a reinforcing event results in fear/anxiety, whereas a failure to control the occurrence of a reinforcing event results in frustration. These emotional reactions facilitate adaptation in cases where prediction and control are compromised. Fear/anxiety serves to heighten vigilance and, thereby, improves the likelihood of anticipating future stimulus events associated with reinforcement. Frustration, on the other hand, serves to invigorate or amplify behavioral efforts aimed at restoring instrumental control over available reinforcers.

Within certain limits, both anxiety and frustration contribute beneficially to the efficiency of the learning process. However, in cases involving high levels of fear or frustration, learning may be adversely affected by these otherwise potentiating and useful states. Under conditions involving high levels of anxiety (unpredictability) and high levels of frustration (uncontrollability), a variety of conflict-driven learning dysfunctions are precipitated. Learning situations in which significant events are both unpredictable and uncontrollable are prone to produce pathological emotional states (e.g., PTSD) and abnormal behavior patterns (e.g., learned helplessness—see Chapter 9). On the other hand, a high degree of control and predictability over significant resources and stimuli occasioning their presentation or escape-avoidance (as may be appropriate from moment to moment) fosters successful adaptation and a sense of well-being.

To a considerable extent, it boils down to a matter of whether one views punishment from the perspective of an event produced by behavior (the animal's perspective) or as an event done to behavior (the trainer's perspective).

PREDICTION-CONTROL EXPECTANCIES AND ADAPTATION

The central control of approach and escape-avoidance behaviors depends on various prediction-control expectancies and cost-benefit appraisals. Prediction and control expectancies share a common cognitive axis mediating reinforcement and punishment. Together, such expectancies guide all purposive behavior, including appetitive and escape-avoidance behavior. These various expectancies are either confirmed (verified) or disconfirmed. Disconfirmation of an instrumental expectancy results when the attractive outcome produced is more (reinforcing) or less (punishing) than expected. Taken together, efforts to control and predict the occurrence of significant events form expectancies such that, given some set of antecedent circumstances, an effortful behavior *a* will result in producing a consequence or outcome *b.* If the expectancy is confirmed, it is kept in tact, whereas if the expectancy is disconfirmed, both predictive assumptions and control efforts are altered, thereby making them more accurately fit the given circumstances. Predictive disconfirmation involving attractive outcomes results in increased arousal in the opposing directions of surprise or disappointment, depending on whether the outcome was more (surprise) or less (disappointment) than expected. In the case of aversive out-

comes, disconfirmation results in arousal in the opposing directions of startle or relief, depending on whether the event was more aversive (startle) or less aversive (relief) than expected. Surprise and relief serve to mobilize learning efforts and represent an important source of reinforcement. Predictive disconfirmation involving disappointment is correlated with need-anxiety, whereas disconfirmation involving startle is correlated with threat-anxiety. Both need- and threat-anxiety internally prompt a preparatory adjustment (e.g., increased vigilance and autonomic arousal) and a reappraisal of the working circumstances. As a result, the dog forms new expectancies and behavioral strategies that better conform to the new information that it possesses.

Disconfirmation of control expectancies results in related behavioral and motivational changes in the dog. When the dog's efforts to control attractive resources exceed its control expectancies, then enhanced acquisitiveness or satiation ensues. On the other hand, when behavioral efforts fail to achieve what is expected, frustrative-loss occurs, and the behavior is adjusted in the opposing directions of invigoration-persistence or despair, depending on the dog's motivational state and relevant past experience with the situation. The appraisal of frustrative situations depends on the dog's disposition to persist in the face of frustrative nonreward—a control strategy that reflects its past success in controlling difficult working situations by persisting or trying harder. Repeated control disconfirmations involving attractive outcomes result in motivational changes in the opposing directions of hope or loss-anger. In the case of disconfirmed control expectancies involving aversive outcomes, behavioral adjustment efforts move in the opposing directions of courage (aversive event required less effort than expected) or threat-anger (aversive event required more effort than expected). Aversive events present other problems for the dog. When faced with a situation involving potent aversive events, failure may instigate disorganized efforts involving anger-anxiety loops and aggression. When both aversive and attractive outcomes are under a high degree of predictability and control, security and safety prevail—a state of affairs that continues unchanged until a prediction-control expectancy is *disconfirmed*. Finally, under circumstances in which significant aversive and attractive outcomes are both unpredictable and uncontrollable, pathological helplessness and behavioral disorganization may ensue (see Chapter 9).

Expectancy Disconfirmation and Learning

Behavior is modified as the result of producing attractive or aversive outcomes that *disconfirm* previously established prediction-control expectancies concerning the relative frequency, size, quantity, or quality of those outcomes. At first glance, this may seem paradoxical, until one considers what occurs when a prediction-control expectancy is *confirmed*. Under circumstances in which significant events are both highly predicted and controlled, there is no need for the dog to adjust or change—successful confirmation simply "verifies" and maintains the prediction-control expectancy without modification. Neither the behavior nor the prediction-control expectancy controlling its expression needs to be changed (nor should they be changed) as the result of confirmatory experiences. Confirmation may be rewarding for the dog in the sense of enhancing efficacy beliefs and feelings of well-being, but such confirmation results in little additional adaptation in terms of behavioral acquisition or extinction.

Functionally speaking, reinforcement and punishment do approximately the same thing: They both variably influence the prediction-control expectancies regulating instrumental behavior, thereby optimizing the dog's adaptation and control over the environment, at least insofar as the environment is significant to the dog, that is, represents a potential threat or opportunity. Reinforcement occurs when an instrumental effort succeeds in achieving *more* control over some attractive or aversive event than predicted by the operative expectancy, whereas punishment occurs when an instrumental effort achieves *less* control over some attractive or aversive event than predicted by the operative

expectancy (Fig. 7.4). In both reinforcement and punishment, the operative expectancy is disconfirmed by either increasing or decreasing control over the relevant attractive or aversive event. As a result of such disconfirmation, the prediction-control expectancy is reappraised and modified to render it more fully in accord with circumstances, thus making the dog's future behavioral efforts more accurately fitted to relevant opportunities or threats. Prediction-control expectancies are modified to agree with the cumulative behavioral successes or failures of the dog's behavioral efforts to access available attractive opportunities and to escape-avoid aversive threats.

These countless behavioral efforts and their modification continue until both prediction and control expectancies most adequately and fully provide behavioral control over significant attractive and aversive events. Part of the motivational impetus for these cognitive and behavioral changes is distressful emotional arousal: (1) when prediction expectancies prove inadequate, anxiety ensues, resulting in augmented behavioral vigilance and autonomic arousal; (2) when control expectancies are inadequate, frustration ensues, resulting in behavioral invigoration and persistence; and (3) when, in spite of behavioral effort, significant events remain both unpredictable and uncontrollable, the result is either depression (learned helplessness) or dysfunctional impulsive or compulsive behavioral excesses. Small amounts of anxiety and frustration are highly conducive to learning, whereas excessive amounts of such arousal may profoundly disturb learning and disorganize instrumental behavior.

Practical Example

The following simple experiment seems to confirm that dogs sometimes rely more on their expectations about future events than on immediate information obtained through their senses. The first part of the experiment consists of giving the dog a dozen or so treats exclusively with the right hand. After this preliminary conditioning is carried out, a treat is taken between the thumb and index fingers of each hand and held just in front of the dog's nose, thus giving the dog a clear view of its location. Next, with the treat shifted from the right into the left hand, but still held in full view, both hands are slowly moved laterally apart from one another, forcing the dog to choose between the left or right hand to get the food. Surprisingly, the vast majority of dogs trained in this way choose the empty (right) hand expecting to find the food in it, rather than track the plainly visible biscuit held in the left hand.

One is tempted to speculate that a dog in this case has formed a cognitive expectation about the likely location of food—one that overshadows the immediate and contrary sensory information that indicates otherwise. This effect is often very persistent, with the incorrect "belief" only gradually being disconfirmed and modified to fit the altered circumstances. As dogs recognize that their expectations about the food's location are no longer reliable, they appear to turn their attention away from the faulty cognitive appraisement to focus on local sensory information in an effort to restore or improve their control over the food's presentation.

A general two-part hypothesis is deducible from these observations: (1) When expected outcomes are highly regular and more or less anticipated, dogs may be more likely to make choices based on expectations than on immediate sensory information. (2) When significant outcomes occur on an irregular basis, however, dogs may rely more on sensory information than on expectations derived from past experience. Ultimately, the goal of sensory reappraisal is to adjust a dog's expectations so that behavioral operations are more efficient and neatly fitted to the actual contingencies and demands placed upon it by the environment. As noted above, dogs that base their actions on well-confirmed expectancies are less anxious or frustrated (less stressed) than dogs exposed to uncertain events. In the latter case, dogs must rely on moment-to-moment sensory input and are unable to relax because dependable expectations about the future are not available. The disruptive influence of an unpredictable and uncontrollable environment exercises a de-

structive influence on a dog's adaptation and welfare.

Diverters and Disrupters

An important key to successful training is to identify what the dog is attempting to accomplish by its behavioral efforts. A dog working hard to get food may not find the opportunity to play ball to be an adequate substitute—ball play is irrelevant to the control-prediction expectancies at work. Similarly, giving the dog a biscuit when it wants to play fetch may not represent a reinforcing event, although it may momentarily dampen or replace the dog's interest in chasing the ball. Presenting a ball to a dog who is momentarily interested in food represents a special kind of *surprise*—a diverter. Unlike a surprise, a diverter does not function as a reinforcer, even though it may become a reinforcer as the dog makes *efforts to control* its occurrence. Similarly, behavioral efforts can be disrupted by the presentation of special startling events called disrupters (e.g., a burst of air). The disrupter is presented independently of the dog's ability to control or predict it and is irrelevant to the control-prediction expectancies regulating the behavior occurring at the moment of presentation. The disrupting event is not punishment because the dog is not engaged in behavioral efforts aimed at avoiding or escaping its occurrence. The event serves only to momentarily disrupt behavior. Since there is no effort to control the presentation of diverters or disrupters in advance of their occurrence, such events result in neither punishment nor reinforcement. Their effects are primarily diversionary and disruptive. Both diverters and disrupters are used to initiate novel patterns of behavior that are subsequently brought under the influence of new control-prediction expectancies. Diverters and disrupters are means for initiating new behavior without first punishing or extinguishing already established behavior. Both diverters and disrupters are marking events that set the stage for establishing a new set of control-prediction expectancies with which to organize new behavior.

Another way of appreciating the function of diverters and disrupters is in terms of attractive and aversive establishing operations. Offering a ball to the dog in the above example motivationally diverts the dog from its appetitive interests and raises the likelihood that it will exhibit behavior aimed at controlling the ball. As this transition occurs, the contingent presentation or omission of the ball can then function as a reinforcer or punisher. Noncontingent reinforcement and punishment function in a similar way. For example, giving the dog noncontingent food during greetings turns its attention away from controlling social reinforcers to the possibility of controlling appetitive reinforcers. The initial presentations of food in such situations function as a diverting establishing operation, making it more likely that the dog will emit behavior aimed at controlling the food presentations (e.g., sitting instead of jumping up), thereby making reinforcement or punishment possible through the contingent delivery or omission of the food reward. Diverting and disrupting establishing operations play important roles in the management of a wide variety of behavior problems.

Conclusion

The foregoing methods of analysis and behavior modification are crucial for effective problem solving and routine training efforts. Such methods provide the trainer/behaviorist with a flexible and creative repertoire of alternatives to reactive force and punishment. Dogs trained with behavioral methods take to learning much more actively and exhibit a confidence and optimism that dogs trained with force alone never exhibit. The ideal outcome of behavior modification is the development of a system of communication between owner and dog based on a shared interface of understood expectancies, mutually cooperative and constructive mediational behaviors, and a shared set of common needs served by such interaction. Proper training establishes a foundation of interactive harmony based on realistic boundaries and cooperative exchange.

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8

Aversive Control of Behavior

As we know, however, the dog does not spontaneously perform all the services we require of him. We are often asked whether we should train a dog by kindness or compulsion. A kind heart is certainly an advantage to a trainer, but this alone will not induce the dog to perform reliable service, nor will treatment by those who are inclined and who constantly see "sullen resistance" on the part of the dog and inflict "punishment" accordingly. Good training needs a kind heart as well as a cool and well-informed head for the proper direction of the indispensable compulsion.

KONRAD MOST, *Training Dogs* (1910/1955)

THE AVERSIVE control of behavior plays an important role in dog training and behavior modification. In many training situations and applications, aversive techniques are not only necessary but sometimes even preferable to the various positive reinforcement procedures discussed in the previous chapter. Unfortunately, aversive training methods are often inadequately understood or applied in cases where positive methods would suffice. Although avoidance learning and punishment appear simple on the surface, as one probes the processes involved, it quickly becomes evident that they are far from simple.

FEAR AND PAIN

The most common source of fear is related to the experience of pain. Most dogs show a very strong fearful response toward pain, and the fear of pain is commonly used to study how fear is learned and affects behavior. The power of pain to evoke fear and facilitate fear-related learning is so highly prepared that it is often treated as though fear is simply a conditioned response to stimuli that predict pain. However, the threat of pain is only one of many potential elicitors of fear; other nonpainful stimuli such as loud noises, sudden movements, and isolation (among others) may also elicit fear and support avoidance learning. All of these various fear-eliciting events can also serve to augment or sensitize an animal's response to other sources of fear. Many conditioning accounts seem to presume that fear and pain are coextensive events. This does not appear to be the case. According to current neurobiological research, the widespread assumption that fear is simply a conditioned response to cues associated with pain is not a viable position (Panksepp, 1998). Pain is one of many experiences that is capable of eliciting fear, and the fear of pain is a strong behavioral motivator that plays a valuable role in an animal's successful adaptation. Fear is also a very common source of maladaptive aversive arousal underlying the development and expression of many behavioral disturbances.

NEGATIVE REINFORCEMENT AND AVOIDANCE LEARNING

Negative reinforcement occurs when the probability of a behavior's future emission is increased by (1) escape from ongoing aversive stimulation or (2) avoidance of an anticipated aversive outcome. Notice that the first part of this definition does not require that a dog respond to any predictive stimuli foreshadowing an aversive event. The definition only calls for an escape response terminating ongoing aversive stimulation—that is, the reinforcing event is both *response correlated and response contingent.* In this case, one response turns on the aversive event while another one turns it off. For example, many dogs exhibit a persistent habit of pulling on the leash when being walked. Discouraging such behavior often requires the use of leash prompts applied when the dog starts pulling. After several such corrections, the dog learns to avoid pulling on its leash because pulling behavior has been correlated with the correction. In this case, pulling on the leash is gradually suppressed through punishment and not pulling strengthened through negative reinforcement. After many walks under the influence of these instrumental contingencies, the pulling response itself gradually becomes an avoidance cue signaling the dog to stop pulling.

On the other hand, the second part of the foregoing definition does require that an antecedent signal occur before the onset of the aversive event, thus giving the dog an opportunity to avoid it—the arrangement is *stimulus correlated and response contingent.* For example, dogs being taught not to pull might be signaled just before the delivery of correction by letting loose of the leash slack, thus causing them to avoid the correction by attending to the avoidance cue (the abrupt giving way of leash slack when pulling) that signals them to stop pulling. In this case, the training event is stimulus correlated (the advent of abrupt leash slack while pulling) and response contingent (the anticipated leash prompt can be avoided by slowing down).

Avoidance training requires that contingent aversive stimulation be sufficiently

strong to motivate dogs to avoid its presentation in the future. In the case of an unwanted behavior under the control of extraneous reinforcement, the intensity of the aversive event needs to be approximately correlated with the reward value of the positive reinforcer supporting the competing operant. For example, a dog bolting after a fluttering leaf might require a much smaller correction than the same dog chasing after a fleeing squirrel—a behavior that may require a fairly strong correction to suppress. Gentle leash tugs will not usually cause a pulling dog to give up the habit. From the pulling-dog's perspective, the occasional and mildly irritating tug on the leash is worth the opportunity to freely investigate and pull along as it pleases. In addition to such instrumental considerations, pulling against the leash elicits thigmotaxic reflexes that cause dogs to increase their efforts in an opposite direction to the force applied. The opposition reflex is always a competing or problematic factor in training activities that physically compel dogs to do something against their will.

The opportunity to acquire extraneous reinforcers or to engage in self-reinforcing activities may sometimes be worth even intense aversive outcomes in exchange. Frequently, naive and overly sympathetic owners only gradually intensify the amount of aversive stimulation, believing that such a procedure is fairer than starting at an appropriately intense level for the situation. The problem with such a method is that it systematically habituates dogs to the most important aspect of the correction—its startle effect. The effectiveness of punishment and negative reinforcement depends not so much on its pain-eliciting characteristics as on the elicitation of a startle response. Fear is the central motivational substrate regulating avoidance learning. Dogs learn to fear the presentation of the aversive stimulus or correction and, consequently, learn ways to avoid its onset. Further, the fear-eliciting event serves to reduce the potential reward value offered by competing extraneous reinforcers. Since the elicitation of fear is incompatible with positive reinforcement, attractive distractions are aversively counterconditioned as something to be avoided rather than pursued.

Under response-correlated and response-contingent (Rcl/Rct) avoidance learning, one response turns on aversive stimulation while another one turns it off. As already discussed, pulling on the leash turns on a leash check or some other aversive event, whereas ceasing to pull marks the offset of the correction and possibly the onset of a reward for walking properly. During the early stages of such training, fear elicitation or the discomfort of the correction potentiates intraresponse components readying the dog for avoidance maneuvers (e.g., not pulling). Fear and discomfort occur simultaneously and are reduced together with the cessation of the aversive event. Because fear and its object (e.g., startle or pain) occur closely together, fear cannot serve a predictive function until an anticipatory signal is assigned to it, occurring just prior to the correction. In the case of response-correlated avoidance learning, the affected behavior itself becomes the avoidance cue.

The close relationship between fear and pain raises a number of important considerations for understanding avoidance learning. The only component deriving from the fear/pain response that can support conditioning is fear. The conditioning of pain itself as a conditioned response is not possible. For example, sounding a tone just before self-administering an electric shock will not, even after many trials of painful conditioning, produce an effect in which the tone is capable of eliciting painful electrical sensations. (Some components of the sensation may be conditioned but not the pain itself.) The conditioning of pain as a sensation is apparently blocked by the more pertinent conditioned response of fear elicitation. Even after a single pairing of the tone preceding the shock event, one might be seized with an intense foreboding of the forthcoming shock that the tone predicts. Pain or discomfort appear to be more closely linked with escape from aversive stimulation once it occurs, whereas fear serves to predict, anticipate, and avoid such hedonistically undesirable experiences.

Stimulus-correlated and response-contingent (Scl/Rct) avoidance learning depends on

dogs learning an avoidance signal that predicts a forthcoming aversive event and selects the specific behavior needed to avoid it. Many theoretical issues stem from such learning (Mowrer, 1960; Seligman and Johnston, 1973). One problem is that animals trained to a high proficiency (asymptote) on avoidance contingencies do not typically show signs of fear prior to the emission of the required avoidance response. Instead, they are often very happy and relaxed workers. They appear to know what is expected of them and do it without hesitation and ostensibly without fear. This effect is obvious in the confident performance of an advanced competitor in the obedience ring. So, if avoidance learning is based on fear, why do avoidance-trained dogs not appear to be fearful? Another problematic (and sometimes highly desirable) feature of avoidance learning is its resistance to extinction (Solomon et al., 1953). Once dogs have been trained to sit on command to avoid a leash correction, they may not require another leash correction for many dozens of trials. One would think that after many presentations of the conditioned stimulus (CS) without actual reinforcement with the aversive unconditioned stimulus (US), that the former would rapidly lose its power to elicit fear and fail to motivate avoidance behavior. In fact, it appears as though the fear originally elicited by the avoidance signal gradually undergoes extinction but not the cue's ability to control avoidance responding. For example, during the early stages of avoidance training, dogs may back away or show other signs of fearful arousal, but after many additional trials, they will simply perform the exercise in a relaxed manner, exhibiting no signs of fear whatsoever.

MOWRER'S TWO-PROCESS THEORY OF AVOIDANCE LEARNING

O. Hobart Mowrer (1960) found that many phenomena observed during avoidance acquisition and extinction could not be adequately explained by previous theories of learning. For instance, Thorndike's *law of effect* postulates that behavior followed by reward is *stamped in*, whereas behavior followed by punishment is *stamped out*. The effects of punishment, however, are often more complicated than Thorndike's assessment indicates. Mowrer argued that two direct features are added to the training situation as a consequence of punishment: (1) punishment does not simply suppress an ongoing behavior, it also strengthens behavior directly associated with its termination, and (2) antecedent stimuli and cues occurring prior to the onset of punishment become emotionally conditioned with fear.

Startle devices like the shaker can are commonly used in dog training. Their purpose is to generate a startle effect immediately and directly associated with an unwanted behavior. For example, a common behavior complaint presented for modification is the habit of jumping on countertops in search of food. Since it is intermittently reinforced (sometimes with very large rewards), it can be a very persistent habit and resist suppression. One means of suppressing the tendency is to booby trap the countertop with a suspended shaker can or something else that causes a significant startle. Sometimes, forbidden items themselves are attached directly to the shaker can by a length of fishing line or dental floss. Dogs that attempt to steal a snack are very much startled by the resounding crash caused by their efforts.

Several things happen during such training. Both external cues (the tabletop and tempting food), internal cues (the desire to jump up for food), and the behavior of jumping itself are all associatively linked with the startling event. Also, dogs learn to escape the startling event by excitedly leaping away from the table (if the startle is sufficiently intense, and they are sufficiently sensitive to it). After a few trials, dogs learn to stay clear of tabletops (unless the potential reward of jumping up offsets the threat of punishment). In the foregoing case, a dog's tendency to jump up is conflicted by competing conditioned emotional responses (CERs) and two learned instrumental components: the tendency to jump off has been strengthened by successful escape and not jumping up rewarded with continued safety from the feared event.

In the laboratory, animals are often

trained to jump over a barrier dividing the experimental chamber into two identical compartments. The grid floor is attached to a shock generator. This arrangement is called a shuttle box and is commonly used in the study of punishment and escape-avoidance learning. During the escape phase of training, an electric charge is passed into the grid work of the floor. Animals learn by trial and error to escape the shock by jumping over the barrier into the safety of the other side. After several trials, they learn to escape more and more efficiently by jumping over the barrier as soon as the shock occurs. The avoidance phase of training involves pairing a neutral stimulus (e.g., a light or tone) with the delivery of shock. If a tone is presented just prior to the onset of shock, animals quickly learn to anticipate the occurrence of shock and avoid it by jumping over the barrier as soon as the auditory cue is heard. In the beginning this association may need periodic reinforcement, but as training progresses the animals respond almost without error. Once established, avoidance training is extremely resistant to extinction. Solomon and Wynne (1953) found that dogs trained to avoid traumatic shock under such conditions persisted in the habit long after the threat of shock was eliminated. Resistance to extinction is a peculiar feature of avoidance learning—a feature it shares with learned fears and phobias.

Although the foregoing scenario sounds straightforward enough, several perplexing aspects about avoidance learning prompted Mowrer's attention. One theoretical issue is how avoidance learning is maintained, since the avoidance response is rarely reinforced with shock. Mower proposed a two-factor theory of avoidance learning to account for it. His theory is composed of two distinct parts: a Pavlovian component involving conditioned emotional reactions and a Thorndikian component involving habit formation. The tone in the foregoing arrangement possesses no aversive or fear-eliciting properties until it is classically associated with shock. The tone signal gradually acquires motivational properties originally belonging only to shock itself. Consequently, the tone becomes a CS eliciting various fearful emotional responses and concomitant physiological changes like accelerated heart rate and respiration. Mower theorized that animals find such emotional reactions aversive and learn to escape them in precisely the same way they learn to escape direct aversive stimulation—negative reinforcement. Since jumping the barrier reduces an aversive tension generated by the CS, the response is negatively reinforced. An experiment that is often cited in support of this view of avoidance learning was carried out by Kamin (1956), who found that if the CS was continued beyond the emission of the avoidance response, avoidance learning would be disrupted—that is, the extended CS *punished* the avoidance response. If the termination of the CS were delayed for as long as 10 seconds, avoidance learning was seriously impeded.

Subsequently, Rescorla and LoLordo (1965) performed a series of experiments that provided additional support for the two-factor theory of avoidance learning. In their study, dogs were trained to jump over a barrier without the aid of external avoidance cues (Sidman avoidance task). During this initial avoidance training, the dogs were exposed to regularly spaced shocks that they could avoid with well-timed responding. Once a strong pattern of avoidance responding was established, they were exposed to a classical conditioning procedure. Some of the dogs were presented a tone stimulus (CS1) that was regularly followed by shock after a variable delay. Another group of dogs was exposed to the same CS1, but instead of receiving shock, they were exposed to another tone stimulus (CS2)—a stimulus that was never followed by shock. The dogs' differential rate of avoidance responding in the presence of each CS arrangement was then measured. Dogs exposed to CS1 and shock were significantly more active avoidance responders. Their rate of jumping over the barrier was significantly increased whenever the tone stimulus was turned on. The other group in which CS1 was followed by another tone (but never shock) made fewer avoidance responses. The first preparation (CS1-shock) augmented avoidance responding while the latter (CS1-CS2) depressed such responding. In a sense, the dogs were less worried about the occurrence of shock in the presence of

the CS1-CS2 arrangement. CS1 followed by CS2 predicts the absence of shock—that is, it is a "safety signal." These experiments demonstrate that some variable emotional factor alleviates or potentiates avoidance responding. In the presence of inhibitory CS1-CS2 (predicting the absence of shock) avoidance responding decreases, whereas in the presence of the excitatory CS1-shock (predicting the presence of shock) avoidance responding increases.

Mowrer progressively refined his analysis of avoidance learning and gradually modified his theoretical interpretation of two-factor learning. The bulk of these changes leaned in the direction of the cognitive learning theory of Tolman (1934). The two parts of his avoidance paradigm, corresponding to classical and instrument conditioning, were referred to, respectively, as *sign learning* (or the *what* to escape) and *solution learning* (or the *how* to escape). He viewed two-factor learning theory as a *creative synthesis* bridging traditional views of learning with Tolman's cognitive viewpoint:

> Reflexology (used here to include Thorndikian habit theory as well as Pavlovian conditioning) and cognition are, in some ways, poles apart—one being behavioristic and the other mentalistic—but two-factor theory represents an effort to bring about a creative synthesis thereof. We discard the notion that behavior itself is learned, whether as habit or as conditioned reflex; but we retain the concept of conditioning and, with Tolman, use it to explain how certain internal events get attached to new (extrinsic or intrinsic) stimuli. But whereas Tolman identified these internal events as "pure cognition," we see them, simply but more dynamically, as hopes and fears. And these then guide, select, or control behavior along lines which are, generally speaking, adaptive—a phenomenon which both Thorndike and Pavlov, in their different but equally oversimplified ways were also attempting to account for. (Mowrer, 1960:323)

The expectancy theory of avoidance has received a great deal of scientific interest, with many experiments having been carried out to determine the relative contribution and importance of emotional conditioning versus cognitive information in the formation of avoidance signals.

A Cognitive Theory of Avoidance Learning

Seligman and Johnston (1973) articulated a cognitive theory of avoidance learning. According to this viewpoint, avoidance signaling results from both emotional conditioning and cognitive information processing of a form roughly corresponding to that outlined by Tolman. Although the acquisition phase of avoidance learning undoubtedly involves the conditioning of fear-eliciting avoidance cues, according to Seligman and Johnston (1973) this emotive phase is slowly subsumed under a more cognitive one. Avoidance training depends on dogs acquiring an expectation that their behavior controls the occurrence of such aversive events. This expectancy is confirmed (negatively reinforced) whenever a dog performs the assigned task within the time frame allotted for its emission. Essentially, the dogs learn to control the incidence of aversive stimulation by responding appropriately to available avoidance cues, thereby confirming the operative expectancy underlying the avoidance behavior.

According to Mowrer's two-factor theory of avoidance learning, fear reduction is viewed as the active reinforcing substrate maintaining avoidance behavior. However, as has been noted, this scenario is inconsistent with what actually appears to occur during avoidance training. In particular, this view conflicts with the relatively anxiety-free character of behaviors acquired through such learning and their unique resistance to extinction. Both factors suggest that the dynamics maintaining avoidance acquisitions do not depend exclusively on fear reduction. According to Seligman and Johnston's cognitive theory, instead of reducing fear of impending aversive stimulation, the learned avoidance behavior is maintained because it consistently confirms an expectancy that such behavior will successfully avoid the aversive event. As additional successful avoidance trials take place, this expectancy and its reinforcing confirmation produce increasing lev-

els of confidence in the presence of fear-eliciting stimuli, and, as long as this expectancy is not disconfirmed by punishment (i.e., the presentation of the negative reinforcer), the behavior will be maintained at a high operant level on the basis of confirmation alone.

In effect, the avoidance signal functions in an identical manner to that of the discriminative stimulus (S^D) during positive instrumental learning. The S^D announces a moment where a reward is forthcoming, given that the dog emits the selected behavior in a timely manner. Dogs learn over several trials to expect a reward when they respond appropriately. When this expectation is confirmed by reinforcement, the linkage between the S^D and the behavior is strengthened or stamped in and extinguished or stamped out when the expectation is disconfirmed by the omission of reinforcement. For example, if a dog was trained to sit under two different signals and then exposed to a situation in which one of the signals is followed by the omission of reinforcement while the other continues to be associated with its presentation, the dog will subsequently learn to sit under the signal confirmed by reinforcement but not sit under the signal predicting the omission of reinforcement. The instrumental response of sitting per se is not affected by this training arrangement. What is affected is the stimulus control exercised by the two signals over the emission of the sit response. In the case of positive reinforcement, learning is based on the acquisition of a promised or hoped-for outcome in the form of a reward. In avoidance training, learning is based on behavior that successfully avoids the presentation of an aversive stimulus together with the concurrent production of emotional *relief* or relaxation as the result of having removed (postponed or avoided) the impending threat. Both positive and negative reinforcement paradigms depend on learned expectancies based on a history of confirmatory outcomes. These paradigms of learning are usually considered as two separate ways in which learning takes place. Viewing them as two sides of a single process within a broader context of expectancy and confirmation helps to clarify the nature of learning itself, and the respective role each reinforcement paradigm plays in the learning process.

Safety Signal Hypothesis

Another theoretical account of avoidance learning that has many adherents is the safety signal hypothesis. The aforementioned experiment by Rescorla and LoLordo (1965) is frequently referred to in support of this theory. Recall that as a result of the differential conditioning of CS1 (correlated with shock) and CS2 (correlated with the absence of shock), the rate of jumping over the barrier was increased in the presence of the stimulus previously associated with shock (CS1) and depressed in the presence of the tone stimulus that had been previously conditioned to predict the absence of shock (CS2). In the presence of the CS2 or safety signal, the dogs appeared to feel more relaxed or *safe* even though the signal had no real relevance to the actual arrangement of the avoidance contingencies involved.

The safety-relaxation theory suggests that dogs experience stimuli associated with relief from aversive stimulation as though they were positive reinforcers. These observations are relevant to traditional dog-training methodology. In addition to establishing various conditioned associations with rewards (e.g., food and ball play), praise represents a safety signal of some importance and usefulness. Interestingly, within the context of behavioral training, *praise* appears to derive a significant portion of its associative strength and reward value from its being paired regularly with the pleasurable relief occurring immediately after the corrective event. Because praise consistently *predicts* the absence of aversive stimulation and is paired with emotional relief from aversive stimulation, it gradually becomes highly desirable in itself and may be treated as a kind of conditioned positive reinforcer.

A leading proponent of the safety-relaxation theory of avoidance learning is M. Ray Denny (1971). His theory owes heavily to the stimulus-response contiguity theories of Pavlov and Guthrie. According to Denny,

avoidance responding is acquired through the antagonistic dynamics of fear and relief-relaxation. Within the context of aversive situations in which fearful withdrawal or escape reactions result in the termination of the fear-eliciting stimuli involved, relief or relaxation responses are subsequently elicited that mediate approach behavior. These successive relief and relaxation responses serve to reinforce avoidance behavior. Relief and relaxation are differentiated along two primary dimensions: (1) Relief occurs shortly after the offset of the aversive stimulus and decays rapidly, whereas the onset of relaxation is both delayed and longer lasting. (2) Relief involves a strong autonomic factor, whereas relaxation involves striatal muscles and various motoric components. Relief begins approximately 3 to 5 seconds after the withdrawal of aversive stimulation and continues for 10 to 15 seconds. Relaxation, on the other hand, is a more sluggish response, requiring approximately 2.5 minutes to produce full benefits. Ideally, avoidance training should include conditioned safety or relief signals that are presented 2 to 5 seconds after the termination of aversive stimulation and continued for several seconds thereafter (Denny, 1976). The intertrial interval between exposures should be at least 2.5 minutes for optimally efficient avoidance training. Denny noted that "the effects of safety appear to double when both relief and relaxation, rather than one of them, are associated with a particular stimulus" (Denny, 1983). Such safety signals take on conditioned positive-reinforcing properties. Experimental support for this general idea has been reported by Weisman and Litner (1969), who demonstrated that behavior maintained on a Sidman avoidance schedule could be differentially increased or decreased by presenting a CS that had been previously associated with relief from aversive stimulation.

Not only does relaxation positively support avoidance learning, it also simultaneously results in its gradual extinction. Extinction occurs as the result of *backchaining* and counterconditioning effects originating in the safe, relaxed situation and generalizing step by step back to the original aversive situation. After many trials of avoidance learning, previously feared stimuli belonging to the aversive situation are backchained and counterconditioned by the relaxation and comfort associated with safety.

Tortora (1983) applied the principles of safety training to the treatment of avoidance-motivated aggression in dogs. According to his assessment, aggressive behavior commonly diagnosed as dominance related is often the result of dysfunctional avoidance responding:

> The dogs in this study initially behaved as if they "expected" aversive events and that the only way to prevent these events was through aggression. The consequent reaction of the victim and the family, that is, withdrawal, turmoil, and belated punishment, confirmed the dog's "expectation" and reinforced the aggression. This positive feedback loop produced progressive escalation of the aggressive response, and the avoidance nature of the aggression presumably retarded or prevented its extinction. (1983:209)

The dogs were trained under a variety of conditions to perform 15 behaviorally "balanced" exercises or, as he calls them, operands. An important aspect of Tortora's study was the systematic pairing of a 3-second safety tone with the offset of shock delivered by an electronic collar. The training trials were spaced according to a variable interval of 5 minutes (ranging from 2 to 8 minutes), well within the 2.5-minute intertrial interval recommended by the relaxation theory. Between trials, the dogs were engaged in play. As a result of safety conditioning, the tone gradually became classically associated with relief and relaxation, becoming a conditioned positive reinforcer sufficient to strengthen cooperative prosocial behavior—behavior incompatible with aggression. According to Tortora, an important aspect of intensive avoidance and safety training is that it provides dogs with an alternative nonaggressive coping pattern when exposed to provocative or aversive situations. Tortora noted that dogs appeared to become more and more confident as they progressed through the various stages of training from avoidance to safety.

Another source of theoretical support for

the safety-relaxation theory of avoidance learning comes from opponent-process theory (Solomon and Corbit, 1974), which postulates that the offset of any hedonically significant stimulus results in a recoil of opposing emotional reactions (see Chapter 6). The withdrawal of aversive stimulation evokes opposing pleasurable emotional reactions. When an aversive stimulus is terminated, the opposing pleasurable recoil provides a source of covert reinforcement, either strengthening desirable alternative behavior or inadvertently reinforcing undesirable behavior.

Following the application of aversive stimulation, it is vital that some positive behavior be selected and prompted. Applying aversive stimulation without providing dogs with an opportunity to perform some alternative option risks the possibility that an undesirable competitive pattern, like running away or avoiding the owner, might be strengthened. The somewhat common practice of isolating or ignoring dogs after punishment is counterproductive from this perspective and should be assiduously avoided. The most efficient aversive events are those that simultaneously suppress an unwanted behavior while evoking a more desirable or incompatible alternative to take its place. This arrangement is commonly used during formal obedience training where unwanted behavior is suppressed by timely correction, which in turn prompts the desired response. A well-designed correction always functions in this dual manner.

Relief may by usefully employed in conjunction with aversive counterconditioning. A common behavior problem seen among puppies and dogs involves inappropriate appetitive interests, that is, attraction to some forbidden object as a chew item. By exposing a dog to a sufficiently aversive-startling stimulus at the moment the object is approached, the dog will quickly acquire a negative conditioned association with the item (determines that it is unsafe) and avoid it in the future. Interest and approach are replaced by distrust and avoidance as a result of the startling experience. Recognizing that a corresponding degree of pleasurable relief is bound up with the event, it is advisable to present the dog with an alternative, safe chew item shortly after applying the startle. Opposing the startle response are opponent approach-appetitive recoil affects associated with relief that help to make the alternative item more attractive and desirable.

Species-Specific Defensive Reactions and Avoidance Training

Some interesting speculation on avoidance learning has advanced the idea that animals undergoing aversive stimulation respond in species-specific ways, thereby facilitating some forms of avoidance learning while impeding others (Bolles, 1970, 1973). According to Bolles (1970), animals are innately prepared to react to novel or startling stimuli with a limited set of defensive behaviors. These species-specific defensive reactions (SSDRs) do not depend on learning for their expression: they are motivationally and topographically stereotypic, possess an evolutionary significance, and exhibit a low threshold for expression:

> What keeps animals alive in the wild is that they have very effective innate defensive reactions which occur when they encounter any kind of new or sudden stimulus. ... The mouse does not scamper away from the owl because it has learned to escape the painful claws of the enemy; it scampers away from anything happening in its environment, and it does so merely because it is a mouse. The gazelle does not flee from an approaching lion because it has been bitten by lions; it runs away from any large object that approaches it, and it does so because this is one of it species-specific defensive reactions. Neither the mouse nor the gazelle can afford to learn to avoid; survival is too urgent, the opportunity to learn is too limited, and the parameters of the situation make the necessary learning impossible. The animal which survives is one which comes into its environment with defensive reactions already a prominent part of its repertoire. (1970:33)

Bolles has argued that SSDRs can either facilitate or impede avoidance training. Depending on the species involved, aversive stimulation evokes varying degrees of immobilization, flight, or active defensive reactions.

Avoidance or escape responses that are similar to an animal's natural defensive repertoire are most easily learned; in the language of Seligman (1970), the responses are *prepared*, whereas those avoidance responses that are dissimilar or incompatible with the animal's natural defensive repertoire are either *unprepared* or *contraprepared* for such training. For instance, teaching rats to lever press to avoid shock is relatively hard to accomplish. In comparison, training rats to jump over a low hurdle or to run to the opposite side of a training compartment is much more easily attained. Ostensibly, jumping and running are high-priority defensive reactions in rats, whereas lever pressing is not. The latter response may be more directly associated with appetitive-consummatory activity associated with the search for food and eating it.

Hineline and Harrison (1979) challenged Bolles's theory of prepotent species-specific avoidance responding. In a series of experiments, they compared the differential acquisition of lever pressing with that of lever biting in rats. The operative assumption was that lever biting should prove innately prepotent over lever pressing and, therefore, be learned more rapidly. Instead, they found that rats actually learned lever pressing more rapidly than lever biting. Their findings, however, are not inconsistent with predictions based on Bolles's SSDR theory of avoidance learning. The study simply demonstrates that lever biting is not prepotent over lever pressing in rats. The researchers appear to have been misled by a presumption that defensive aggression ought to be prepotent over other escape-avoidance actions, such as lever pressing. In fact, under conditions of aversive stimulation, attack may not be prepotent over other escape possibilities. Azrin and colleagues (1967) found that escape was typically dominant over attack in rats and was only likely to occur when (1) escape was otherwise not possible or (2) when the escape requirements were too difficult. Also, although attack behavior tended to interfere with escape behavior during the acquisitional phases of training, this early attack behavior quickly diminished as the escape response was mastered.

In dogs, many competing SSDRs occur during the early stages of obedience training. According to Bolles, "The trick in the avoidance situation is to punish all of the wrong responses so that the right response will occur" (1973:299). Dogs being trained with forceful methods typically react by systematically experimenting with various defensive postures and reactions that are prepotent to the dog as a species. These defensive behaviors range from bolting and jumping up, to dropping down and freezing; balking and struggling to pull away, or biting the leash. Some dogs exhibit a wide variety of passive submissive displays or, in the opposite extreme, occasionally threaten or snap at the handler. The early stages of avoidance training (really punishment training) involve systematically suppressing these innate defensive reactions and replacing them with forcefully prompted alternatives. Only once all defensive reactions are punitively suppressed or reduced to the *obedient* target response does systematic and formal avoidance training begin.

PUNISHMENT

Punishment is an inescapable fact of life. From a behavioral perspective, punishment is everywhere, defining what will and will not occur without discomfort or disappointment. Taken together, the escape-avoidance of aversive events and the acquisition-maximization of rewarding ones form the yin and yang of behavior. Confucius discerned the importance of difficult trials in one's life: "The gem cannot be polished without friction, nor man perfected without trials." Similarly, Aristotle extolled the virtues of pleasure and pain for achieving the "happy life." In his *Nicomachean Ethics* (1985), he writes,

> For pleasure is shared with animals, and implied by every object of choice, since what is fine and what is expedient appear pleasant as well.
>
> Further, since pleasure grows up with all of us from infancy on, it is hard to rub out this feeling that is dyed into our lives; and we estimate actions as well [as feelings], some of us more, some less, by pleasure and pain. Hence, our whole inquiry must be about these, since

> good or bad enjoyment or pain is very important for our actions. (1985:38)

Later, he expands on this general theme:

> The next task, presumably, is to discuss pleasure. For it seems to be especially proper to our kind, and hence when we educate children we steer them by pleasure and pain. Besides, enjoying and hating the right things seems to be most important for virtue of character. For pleasure and pain extend through the whole of our lives, and are of great importance for virtue and the happy life, since people decide to do what is pleasant, and avoid what is painful. (1985:266)

Properly understood, reward and punishment are morally neutral, the one being neither better nor worse than the other. Both outcomes serve equally vital functions in perfecting an animal's adaptation to the social and physical environment. Learning to respond and cope appropriately with the treats and trials of life is an important part of normal development for dogs and humans alike. One need but think about walking into the path of a moving car, cheating on one's spouse, approaching a snarling dog, or stepping on a pin to feel the inhibitory and protective benefits of punishment. Although punishment is unpleasant, precisely that aspect makes it so beneficial and useful. It is far better to experience a little fear or pain than to be severely injured or utterly destroyed as the result of its absence.

Definition

The terms *punishment* and *negative reinforcement* are often used vaguely or interchangeably with each other. However, punishment and negative reinforcement operate in quite different ways and serve entirely different functions. Although punishment and negative reinforcement often occur together, by definition, punishment is functionally the opposite of negative reinforcement. A behavior is negatively reinforced when its emission is made more likely in the future as a result of its either avoiding or terminating the presentation of an aversive event. In contrast, punishment occurs when the emission of a behavior is made less likely by the presentation of an aversive event (positive punishment) or by the withdrawal of a desirable one (negative punishment). *Negative punishment* (P–) causes an effect opposite to that of positive reinforcement. Conversely, *positive punishment* (P+) results in an effect opposite to that of negative reinforcement. Both positive and negative reinforcement function to strengthen behavior, whereas the function of punishment is to weaken it. With this functional consideration in mind, Azrin and Holz (1966) defined *punishment* as "a consequence of behavior that reduces the future probability of that behavior" (1966:381). Punishment has one functional purpose: the suppression of the punished behavior. Through punishment, dogs learn that performing a particular act turns on an aversive event (P+) or results in the loss of a desirable one (P–). Given that the punitive event (positive or negative punisher) is sufficiently aversive or costly, dogs will be less likely to emit the punished behavior in the future—that is, the behavior has been suppressed.

Critics of Punishment

Unfortunately, not only is punishment often poorly understood as a behavioral procedure, it is just as often bogged down in dire warnings of serious side effects and, more importantly, the false view that it does not work. Understanding how these criticisms and myths developed begins with a look at how Thorndike viewed punishment. Initially, Thorndike (1911/1965) believed that the effects of reward and punishment were symmetrical opposites, with the former strengthening behavior while the latter weakened it. In his later writings, this original formulation of the *law of effect* underwent significant modification (Hilgard and Bower, 1975). These changes came about as the result of additional animal and human studies that Thorndike carried out using mild (annoying) punishment. Briefly, for example, in one study with human subjects learning a vocabulary task, he found that the social reward or satisfier "right" helped participants to learn correct verbal responses, but the punisher or annoyer "wrong" failed to produce a corresponding decrease in the overall number of

mistakes made by the subjects. In another study involving punishment of animals, he trained chicks to choose between three arms of a simple maze. Choosing the correct arm led to a compartment containing other chicks eating grain (strong social and appetitive incentives). Choosing the wrong arm resulted in social isolation for 30 seconds. He found that correct choices were stamped in, but incorrect ones, contrary to predictions based on the original law of effect, were not stamped out. These findings led him to conclude that punishment was less efficacious than reward. Unfortunately, as will be recognized by astute readers, the foregoing experiments prove only that the punishers used in his experiments were insufficient to suppress the target behaviors being punished. Neither experiment says anything very significant about the effects of punishment per se, but only that the punishment procedures employed were not very effective. Despite the absence of much in the way of strong evidence, Thorndike (1931) and his colleagues eagerly generalized from such findings as the foregoing to conclude that punishment, as a rule, did not weaken instrumental behavior. While he still recognized the power of punishment to disrupt behavior, he no longer believed that punishment was an adequate and efficient means for altering learned connections:

> Annoyers do not act on learning in general by weakening whatever connection they follow. If they do anything in learning, they do it indirectly, by informing the learner that such and such a response in such and such a situation brings distress, or by making the learner feel fear of a certain object, or by making him jump back from a certain place, or by some other definite and specific change which they produce in him. (1931:46)

Thorndike and his followers subsequently collected and published numerous testimonials and tracts in support of the superior effectiveness of reward to bolster this somewhat extreme and counterintuitive position with respect to punishment (Hilgard and Bower, 1975).

Following in the tradition of Thorndike, B. F. Skinner (1974) also viewed the effects of reward and punishment asymmetrically, placing far greater emphasis on the use of positive reinforcement for altering and controlling behavior than he attributed to punishment and negative reinforcement. Despite a large body of contrary evidence, Skinner believed that punishment exercised a temporary influence over behavior and was loaded with negative side effects. He argued along with Thorndike that punishment only transiently disrupts behavior, causing emotional disturbances and behavioral disorganization—not suppression. According to Skinner, punished behavior tends to recover quickly once the punitive contingency is withdrawn, and the animals are given time to recover their shaken composure. This position has been criticized by leading behavior analysts, including Hineline:

> Within behavior analysis, Skinner has consistently advocated keeping punishment in a separate domain. Initially, the balance of data supported that view. ... However, Skinner has continued to argue—in the face of accumulating contrary data—that punishment procedures produce only indirect effects on behavior, and has emphasized temporary effects of punishment when punishment procedures are discontinued. Of course reinforcement procedures are similarly temporary when reinforcement procedures are discontinued. (1984:496)

Perhaps, the most important consideration influencing Skinner's rejection of punishment was a concern about its potential for producing private (distress) and social adverse side effects, especially evasion or retaliation. Although aversive stimulation is capable of evoking serious side effects, they usually occur under specific conditions and as the result of abusive treatment—not punishment. Murray Sidman (1989) has written at length regarding the various side effects and problematic features associated with *coercive* methods of control. In the tradition of Thorndike and Skinner, Sidman argues (sometimes convincingly, sometimes emotionally) that most behavioral manipulations and modifications can be achieved without resorting to aversive methods. There can be little disagreement with the selection of training methods that utilize positive reinforcement whenever possible, but to exclude punishment arbitrarily from a trainer's armamentarium would be counterproductive and artificial.

Although Thorndike's revised opinions about punishment were subsequently repudiated, his emphasis on reward training provided a propitious rebuttal against an equally extreme distortion about the superior efficacy of punishment current at the turn of the century. The primacy and effectiveness of punishment was vigorously defended by many parents, educators, and dog trainers. According to S. T. Hammond, dog training during this time was often an unpleasant and grueling process for dogs; he lamented over the severity of his contemporaries and their excessive reliance on force for *breaking* their hunting dogs:

> Nearly all writers upon the subject of the dog agree that there is but one course to pursue; that all knowledge that is not beaten into a dog is worthless for all practical purposes and that the whip, check-cord and spike-collar, with perhaps an occasional charge of shot or a vigorous dose of shoe leather, are absolutely necessary in order to perfect his education. (1894:1)

Since this early call for reform, a tremendous amount of progress has been made in the art and science of dog training, making it both more rational and humane. Similarly, Skinner's positive contribution to rational training methodology cannot be overly praised and should be the object of intensive and thorough study by anyone aspiring to become a professional dog trainer. However, and with all due respect for the accomplishments of both Thorndike and Skinner, some of their more extreme views about punishment must be questioned in the light of scientific advances and the empirical findings derived from practical experience.

Since Thorndike's time, the pendulum has swung from a stubborn reliance on punishment and negative reinforcement to an equally unnatural extreme in which the use of punishment and negative reinforcement (in some quarters) is shunned to embrace a so-called "positive" approach to training and behavioral control. Extreme positions, whether based on good intentions or not, are typically based on irrational beliefs and assumptions—not scientific knowledge and experience. The adoption of an exclusive reliance on punishment or reward alone reflects a core of misunderstanding about how dog behavior is most efficiently modified. Such positions are doomed to miss the mark, since they are based on a distortion of the subject matter and basic facts. Montaigne, in his essay *Of Moderation*, wrote correctly with respect to extremist positions: "The archer who overshoots his mark does no better than he who falls short of it. My eyes trouble me as much in climbing upward toward a great light as in going down into the dark." Despite the current wave of vocal enthusiasm and polarizing debate about the virtues of positive reinforcement and the evils of punishment, the vast majority of dog trainers and behaviorists remain pragmatic opportunists about the use of reward and punishment—that is, they do what *works* within the context of practical considerations and ethical standards. Punishment is unpleasant (both for dogs and for trainers) and, whenever possible, reward-based instead of punishment-based methods should be used, but sometimes the effects of punishment are simply more expedient, reliable, and enduring than the results of positive reinforcement alone. Certainly, there are occasions when punishment and other aversive training procedures simply cannot be avoided, where "punishment procedures even provide the most effective basis for humanely achieving social good" (Hineline, 1984:496). Punishment is especially beneficial in cases in which a dog's unwanted behavior endangers either the dog itself or others with whom the dog comes into contact. In such cases, where an immediate and more or less permanent change is needed, punishment has many advantages over positive reinforcement. Of course, humane trainers select the least intrusive punishment necessary to achieve their behavioral objectives and strive to minimize its use whenever possible. The aim of punishment is to eliminate the use of punishment in the future. Instead of extreme positions, accusatory innuendo, moralizing, and half-truths, what is needed is a balanced and informed attitude regarding the practical use, misuse, and abuse of punishment.

A similar controversy is ongoing among applied behavior analysts and other practitioners using *gentle teaching* procedures to in-

struct persons suffering mental retardation and other debilitating disorders (Jones and McCaughey, 1992). Advocates of gentle teaching emphasize the importance of bonding, mutual change, trust, and accommodation—that is, the formation of a fulfilling and reciprocal relationship between clients and caregivers. There is nothing inherently inconsistent with these worthy goals and behavior modification, except that *gentle teachers* believe that such goals should be attained through nonaversive means *only.* Consequently, they reject any use of aversive training measures as "sinful" and dismiss the behavioral approach as a "culture of death" based on "deliberate torture." This sort of divisive polarization of views is also evident in some camps of quarreling dog-behavior modifiers, especially those regarding a similarly one-sided gentle-training approach as the only humane approach to dog training.

Does Punishment Work?

In Lewis Carroll's "The Hunting of the Snark," the Bellman woos his crew to believe that truth is sanctioned by his earnest repetition of some statement—no matter how false or ludicrous it happens to be:

> "Just the place for a Snark!" the Bellman cried,
> As he landed his crew with care;
> Supporting each man on the top of the tide
> By a finger entwined in his hair.
>
> "Just the place for a Snark! I have said it twice:
> That alone should encourage the crew.
> Just the place for a Snark! I have said it thrice:
> What I tell you three times is true."

Many critics of punishment seem to be guided by a similar criterion of truth, believing that the heartfelt repetition of a falsehood is enough to make it true. Despite the lingering historical influences already discussed and contemporary efforts to misrepresent its usefulness, the efficacy of punishment is not really in doubt, especially if science is accepted as the final arbiter of the debate. The facts are clear and indisputable: When applied properly (promptly and in the correct measure), punishment works, it works quickly and, in many cases, the suppressive effects of punishment are permanent. Among several hundred scientific studies demonstrating the efficacy of punishment, Azrin and Holz state the situation in certain and unambiguous terms:

> One of the most dramatic characteristics of punishment is the virtual irreversibility or permanence of the response reduction once the behavior has become completely suppressed. Investigators have noted that the punished response does not recover for a long period of time even after the punishment contingency has been removed. ... How quickly does punishment reduce behavior? Virtually all studies of punishment have been in complete agreement that the reduction of responses by punishment is immediate if the punishment is at all effective. When the data have been presented in terms of the number of responses per day, the responses have been drastically reduced or eliminated on the very first day in which punishment was administered. (1966:410)

Although it is true, as Skinner noted, that mildly punished behaviors tend to recover when the punitive contingency is discontinued, a comparable effect is also observed in the case of behavior under the control of positive reinforcement. Both punished behavior and rewarded behavior tend to recover or extinguish when the punitive or reinforcing contingency is withdrawn. The main difference between positive reinforcement and punishment in this regard is that the latter appears to exert a much more rapid and permanent modification of behavior than produced by the former. In response to Skinner's assertion that "punishment is ineffective," John Staddon writes,

> Well, no, it isn't. Common sense aside, laboratory studies with pigeons and rats (the basis for Skinner's argument) show that punishment (usually a brief electric shock) works very well to suppress behavior, as long as it is of the right magnitude and follows promptly on the behavior that is to be suppressed. If a rat gets a moderate shock when he presses a bar, he stops pressing it more or less at once. ... Does the punished behavior return when the punishment is withdrawn? That depends on the training procedure. An avoidance procedure called shock postponement, in which the rat gets no shock so long as he presses the bar once in a while, produces behavior that can persist indef-

initely when the shock schedule is withdrawn. (1995:92)

Besides misrepresenting and confusing the facts, excessive moralizing about the use of punishment and other aversive training procedures may have a very undesirable effect on the dog-owning public, making responsible owners feel guilty about exercising the necessary aversive prerogatives needed to establish constructive limits and boundaries over a dog's behavior. Many of the basic facts of life that all dogs must learn to accept (if they are to become successful and welcome companions) are won through the mediation of directive training, combining a balanced application of behavior modification—not just positive reinforcement. Instead of grinding away at a very dull ax, a dog's welfare is better served by teaching the owner when punishment is necessary and how to use it effectively and humanely.

Punishment and "Neurosis"

A reasonable concern underlying the rejection of punishment is its potential role in the etiology of *neurosis* in dogs. This concern is validated by a considerable body of experimental literature. Numerous studies (e.g., by Pavlov, Wolpe, Masserman, Liddell, Maier, and Seligman) have confirmed the dangers of aversive stimulation under certain conditions—concerns that are discussed in detail in the following chapter. Puppies exposed to excessive physical punishment may be more difficult to manage later as the result of the lasting effects of traumatic stress. Abusive treatment and stressful rearing practices are associated with many of the following symptoms, all of which have a direct relevance for the welfare and development of dogs: (1) hypervigilance and irrational fear, (2) heightened irritability, (3) impulsive-explosive behavior, (4) hyperactivity, (5) aggression evoked with minimum provocation, (6) withdrawal and social avoidance, (7) anhedonia (loss of sensitivity to pleasure and pain), and (8) depressed mood. Most cases in which punishment is associated with serious side effects involve rather special applications of punishment. Especially important are such factors as intensity, predictability, and control—vital factors in the effect and side effects of punishment. Solomon (1964) noted four specific conditions that are necessary for punishment to result in maladaptive behavior: (1) the stimulation generates vigorous and sustained emotional arousal, (2) the stimulation is unpredictable, (3) the stimulation is uncontrollable, and (4) the stimulation is inescapable. All of these criteria are often satisfied by a common form of aversive stimulation: *noncontingent punishment*. The habit of "punishing" a dog long after the behavioral event has occurred does little more than confuse the dog, while quite possibly damaging the dog's trust and affection for the owner. Horace Lytle deftly summarized the adverse effects of unpredictable and uncontrollable aversive stimulation long before the concept of *learned helplessness* was formally articulated: "A dog which is always expecting punishment—never quite sure when it is going to come, and never quite sure why it is being administered—that sort of a dog never amounts to much. And he isn't given a chance to amount to much" (1927:xvi). Such treatment is not punishment at all; it is simply irrational and ineffectual abuse that should be strictly abstained from by professional dog trainers and behaviorists.

Positive Side Effects

Although negative side effects obviously occur and should be carefully assessed before employing punishment, most of these side effects can be minimized. Some side effects of punishment, however, may actually be beneficial (Kazdin, 1989). Punitive events often help to set and enforce social boundaries, promote impulse control, reinforce social status, and provide various other generalized effects that assure an optimal adaptation to the social and physical environment. Many researchers have reported a variety of beneficial side effects directly resulting from the use of punishment, including improved social behavior and cooperation, increased emotional responsiveness and positive mood, the appearance of more appropriate play behavior and other constructive activities, and improved attentional behavior (Newsom et al.,

1983). Even side effects that might be considered adverse may have a beneficial aspect to them, as Azrin and Holz point out:

> When we punish a response, our primary concern is to reduce the frequency of that response. If we have not overlooked the effects of the reinforcement variables or the discriminative variables, there is every reason to believe that our punishment procedure will be completely effective in eliminating the undesired response. The emotional state or enduring behavioral disruption of the punished subject are not necessarily undesirable outcomes of punishment; nor are the severity of the response reduction or the behavioral generalization of the punishing effects undesirable. In fact all of these effects are probably quite useful where a physical punishment is concerned, from an evolutionary point of view, in reducing the future likelihood of painful and possibly destructive events. (1966:442)

The primary negative side effects of punishment are related to its improper use and various disruptive social effects (e.g., fear or aggression directed toward the punishing agent/situation), but punishment is not alone in its potential for producing troubling side effects. Staddon points out that positive reinforcement can produce similar problems:

> Positive reinforcement also provokes counterattack. Every student who cheats, every gambler who rigs the odds, every robber and thief, shows the counterattack provided by positive reinforcement schedules. (1995:93)

Coercive Compulsion and Conflict

Not unexpectedly, aversive events frequently generate high levels of conflict and generalized arousal; effects that may lead to problems if not carefully managed. Problematical aversive compulsion is most commonly found in two general dog-training applications, what Konrad Most (1910/1955) called *compulsive inducement* of action or abstention from action:

Inducing action. Compulsion is applied to *induce* a dog to execute an *action* that it does not want to perform. Under the influence of compulsion, the dog is wedged between two opposing possibilities: performing an undesirable action or being compelled by force (primary inducement) or threat of force (secondary inducement) to perform it. This sort of aversive situation may trigger an avoidance-avoidance conflict, requiring the dog to choose between two equally undesirable alternatives.

Compelling abstention. Compulsion is applied to *compel* a dog to *abstain* from executing an action that the dog wants to perform. In this case, the dog is conflicted between its desire to consummate the forbidden action and the pending threat of aversive stimulation if it fails to abstain from doing so. When the aversiveness of compulsion is motivationally equal to the reward value of the forbidden activity, then a disruptive approach-avoidance conflict may ensue.

These two uses of compulsion correspond to what most trainers refer to as a *correction*. When properly applied in practical dog training, such methods can be efficient and useful. However, such procedures are often used improperly or abusively. Compulsion may produce severe conflicts as the result of a collision of opposing motivational interests. Since conflict has been implicated in the development of experimental neurosis and displacement stereotypies, such treatment as abusive compulsion should be avoided.

Another potential hazard with the use of compulsion is that it may block or interfere with the natural functioning and satisfaction of the targeted behavioral system, possibly generating some degree of internal disruption (stress) and homeostatic imbalance. Behavioral outlets for drive satisfaction are necessary for healthy emotional development and equilibrium in dogs. Often, however, these innate drives are expressed in undesirable behavior that must be modified or redirected for the sake of domestic harmony. Although aversive techniques are often relied upon to achieve such ends, they are not always necessary or desirable. Seven other possible behavioral techniques should be considered before resorting to punishment: (1) modify the unwanted behavior into an acceptable form, (2) modify the environment so that the un-

wanted behavior cannot be performed, (3) redirect the unwanted behavior into a more acceptable outlet, (4) bring the behavior under stimulus control and then signal for it only under acceptable conditions, (5) modify the reinforcement contingencies maintaining the behavior (extinction), (6) select and reinforce an alternative behavior that is incompatible with the undesirable behavior, and (7) in the case of intrinsically reinforced behavior, bring the behavior under the control of an extrinsic reinforcer and then extinguish it. When punishment must be used, it is most effectively employed in a training context where the punished behavior is replaced by an alternative behavior that is subsequently brought under the control of positive reinforcement. Unless the punished behavior is replaced with an adequate substitute, the effect of punishment may be temporary, requiring that it be applied over and over again with diminishing net results.

Another important factor is the strength of the aversive event employed as punishment. The punitive event should be strong enough to evoke an incompatible response to the behavior being punished. Insufficiently strong punishment may only excite dogs, perhaps serving more as a reinforcing event (i.e., negative attention) than a punitive one. Ideally, the cessation of the punitive event and the emotional *relief* associated with its withdrawal ought to coincide with the emission of an appropriate alternative behavior. Therefore, an efficient punishment should consist of at least two elements: (1) punishment should result in the dog emitting some behavior incompatible with the one being punished and (2) the emission of this alternative behavior should occur with the onset of relief from punishment. Unfortunately, sometimes relief from punishment reinforces an equally unwanted behavior. For example, a jumping dog might be successfully punished for jumping up during greeting only to learn to urinate submissively instead when the owner comes home.

Finally, above all other training procedures, punishment requires great knowledge, practical experience, compassion, refined and expert skills, and, most importantly, self-mastery. C. B. Whitford pretty much sums things up with the following sage advice about punishment in a chapter entitled "Breaking the Breaker":

> The rule to follow is: Do as little breaking as possible; try to encourage the dog to do the proper things and develop him as much as possible with the least amount of control. As a final word to the breaker, it may be said that he should so educate himself that he will know that it is always wise, when in doubt, to give the dog the benefit of that doubt. Not only should he know this, but he must have such complete control of his feelings as to give his knowledge effect. The breaker who spends much time in considering his own weaknesses will profit by his effort. (1908/1928:20–21)

P+ and P–: A Shared Emotional and Cognitive Substrate?

As discussed previously in Chapter 6, Konorski (1967) proposed that classical conditioning be analyzed in terms of preparatory and consummatory components. The *preparatory component* includes all the various drive and emotional factors underlying the event, whereas the *consummatory component* refers to the specific appetitive or defensive actions elicited. He argued that preparatory or emotional factors are prepotent over consummatory elements during the conditioning process—that is, learning depends more on emotion than consummatory reflexive actions. This raises a question regarding the emotional substrates underlying punishment. As previously discussed, punishment takes two basic forms: the withdrawal of rewards or the presentation of aversive stimulation. Studies utilizing Kamin's (1968) blocking effect indicate that a similar emotional substrate is involved during both forms of punishment, whether the punitive event is the withdrawal of reward (negative punishment) or the presentation of an aversive event (positive punishment). The blocking effect refers to a phenomenon observed when a compound stimulus is presented (CS1 and CS2) where CS1 has been previously paired with the reinforcing US (e.g., shock). Under an arrangement where CS1 (tone) and CS2

(light) are subsequently presented together, the tone will *overshadow* the light stimulus, causing the latter to remain neutral with regard to the reinforcing US (shock). CS1 is said to absorb all the associative strength that the US can support.

To determine whether negative punishment and positive punishment function similarly, the following experiment could be performed. First a clicker (CS) is paired with food (US) until a strong conditioned response is evident. The second part of the experiment involves presenting a light stimulus together with the previously conditioned clicker, but this combination is never followed by food. Pairing the clicker with the presentation of food generates a strong conditioned response to the sound of the clicker. In the second case, however (where the clicker and light are presented without food), conditioned inhibition (no response) occurs—that is, the compound stimulus composed of the light and clicker predicts no food. Let's take this analysis one step further. Returning to the aforementioned blocking experiment where shock was used as the US, what would occur if the light stimulus previously compounded with the clicker (predicting the absence of food) was compounded with a neutral tone stimulus and paired with shock? This is precisely what Dickinson and Dearing (1979) set out to determine in a similar experiment. Interestingly, the researchers found that the light CS1 blocks conditioning of the tone CS2. This is a rather astonishing result, since the light stimulus had never been actually associated with shock, yet it was able to block conditioning of the neutral tone stimulus.

How might this result be interpreted? It appears as though at some level the animal experiences the loss of reward in much the same way it experiences the presentation of an aversive stimulus. Mackintosh (1983) considered this possibility and argued, using Konorski's paradigm, that the preparatory emotions experienced during aversive stimulation are actually very similar to those experienced during the withdrawal of an anticipated food reward—that is, the feelings elicited by the withdrawal of reward are emotionally analogous to those elicited by aversive stimulation. Although the preparatory emotions associated with the two forms of punishment are not identical, their significant emotional impact is identified as though they were the same—that is, they are associatively linked or identified with the same emotional substrate. Theoretically, such a linkage between positive and negative punishment is a very important finding. These distinct modes of punitive stimulation are obviously differentiated on a physiological level. The only way to identify the two is via an independent organizing concept or shared hedonic category, like "not good" or "disappointment" (i.e., a mediating cognitive construct). If the foregoing interpretation is accurate, it may be misleading to view negative punishment (e.g., extinction) as being significantly "better" emotionally than positive punishment (e.g., shock). Both forms of punishment can cause great anxiety, frustration, and distress if not skillfully employed. On the level of emotional integration, punishment is punishment. Panksepp, while discussing various distinctions between hedonic affects and true emotions from psychobiological perspective, speculated along similar lines of analysis:

> Certainly at the broad functional level, pleasure is a property of external stimuli which help sustain life, while feelings of aversion arise from stimuli which tend to be incompatible with survival. In the simplest brain scenario, it may turn out that the affective properties of various stimuli funnel into a few, perhaps just two, primary affective processes—generalized pleasure (such as might be mediated by brain opioids and/or dopamine) and generalized aversion (perhaps by anti-opioids and anti-dopaminergics)—with the multitude of apparent distinctions being the result of non-affective sensory details. (1988:44)

PUNISHERS, REWARDS, AND VERIFIERS

Whether a given stimulus event is interpreted by a dog as a punitive one or a rewarding one depends on the dog's moment-to-moment motivational state and learning history. As previously discussed in Chapter 7, giving a fully satiated dog a treat may actually function punitively—that is, the dog may experience the ingestion of food when not hungry

as an aversive event. Similarly, a dog that has been exercised to the point of exhaustion will view an opportunity to play very differently than at some other time when the dog is well rested. In general, the provision of anything that the dog would rather be doing at any given moment may function as a reward. On the other hand, anything that the dog would rather not be doing at any given moment might be used as an effective punisher. This general motivational interpretation of reward and punishment has been elegantly described by Premack (1962).

It is useful to interpret ongoing behavior in terms of a *field* of learned *expectations* and controlling *signs*. Dogs make fine predictions from moment to moment based on past experiences, including the identification of signs anticipating future events. In the words of Tolman (1934), "A conditioned reflex, when learned, is an acquired expectation-set on the part of the animal that the feature of the field corresponding to the conditioned stimulus will lead, *if the animal but waits*, to the feature of the field corresponding to the unconditioned stimulus" (1934:393). A common example of classical conditioning in dog training involves the bridging stimulus. Consistently saying "Good" just before giving the dog a piece of food teaches the dog to expect a treat on each occasion it hears the vocal signal. What happens, however, if the vocal signal "Good" is presented independently of the presentation of food—that is, when it is randomly paired or not paired so that the animal cannot predict the actual outcome on any given trial?

Rescorla's (1968, 1988) laboratory findings indicate that if an animal is exposed to random shocks that are signaled only 50% of the time by a tone stimulus but unsignaled the remaining 50% of the time, the result is that the tone will fail to develop as a CS—that is, the animal will fail to respond to the tone as a predictive signal for the occurrence or nonoccurrence of the US (shock). Such stimulus neutrality occurs in spite of many positive pairings between the tone and the US, since the positive pairings are offset by an equal number of US events occurring in the absence of the tone. In this case, the tone equally fails to predict the absence or the presence of the US—that is, it occurs independently of the US. Rescorla's studies prove that the animal forms an expectancy derived from a contingency of probability existing between the occurrence and nonoccurrence of the CS and the US (see Chapter 6). Furthermore, in addition to making predictions about the probable occurrence of the US, the dog also makes predictions about its size and quality. In this regard, associative expectancies between the CS and US yield three general possibilities:

1. The CS exactly predicts the size and quality of the US (*no new learning results*).
2. The CS underpredicts the size and quality of the US (*acquisition*).
3. The CS overpredicts the size and quality of the US (*extinction*).

In terms of conditioned reinforcement, these various relationships between conditioned and unconditioned stimuli result in the following outcomes: (1) If the word signals "Good" or "No" are always followed by the same amount of unconditioned stimulation (the same reward or aversive event), then no new learning takes place (i.e., the strength of the S^rs "Good" and "No" remains the same). (2) If the word signals "Good" or "No" are sometimes followed by a larger-than-expected reward (e.g., a bonus) or an unexpected punisher, then additional associative conditioning takes place. Such stimulus learning is facilitated under conditions of appetitive surprise (Blanchard and Honig, 1976) or aversive startle (Kamin, 1968). (3) If the CS overpredicts the size of the reward or punisher, then extinction occurs. For instance, if dogs have learned to expect a piece of steak each time they hear the word signal "Good" and are then given a biscuit instead, they will quickly adjust their expectations to reflect the disappointment. In the case of punishment, if dogs have learned to expect aversive punishment every time they hear the word signal "No" while engaging in some unwanted behavior but are then exposed to a series of mild physical prompts instead, the fearful emotional and avoidance responding previously controlled by the reprimand will undergo extinction.

During the training process, dogs definitely form certain predictions and expectations about outcomes associated with their behavior. Extrapolating from the foregoing analysis of classical conditioning to instrumental learning, if a dog receives a reward that is significantly smaller than expected, the outcome is perceived as punitive (disappointment), resulting in the trial rendering the response weaker. If, on the other hand, the reward exactly matches the dog's expectations, then the instrumental response that resulted in reward is neither rendered stronger nor weaker than it was before reinforcement. A reinforcer that does not result in additional learning (acquisition or extinction) might aptly be termed a *verifier*, serving to confirm the status quo but not resulting in any new learning. This general theory suggests that a third instrumental outcome exists in learning besides rewards and punishers (i.e., verifying events that function to maintain behavior at the same level of probability). For new instrumental learning to take place, the reward must exceed a dog's expectation—that is, additional positive learning depends on a surprise element. According to this viewpoint, instrumental behavior is strengthened only to the extent that the anticipated reward exceeds the dog's predictions about the reward's size, quality, or context.

Similarly, in the case of punishment, an aversive event that exactly matches a dog's expectations should not alter or weaken the behavior that the aversive event follows—such a well-predicted event serves only to verify the status quo. That the dog anticipates the aversive outcome and still performs the targeted behavior at a steady rate is empirical evidence for such an interpretation. However, if the punitive event exceeds the dog's prediction, then a corresponding degree of suppression will occur. Finally, if the punitive event is less than the dog has predicted, one would likely observe extinction of punishment effects.

Several general outcomes can be anticipated from the reciprocal relationship between the probability of punishment and its intensity:

1. If the probability of punishment is high but intensity low, the degree of suppression will be correspondingly mitigated.
2. If the probability of punishment is low but the intensity high, suppression should likewise decline over time. [This case finds some trouble when compared with findings from traumatic escape-avoidance experiments (Solomon et al., 1953) and *one-trial learning events*. Avoidance learning is typically very resistant to extinction.]
3. The highest degree of suppression occurs when both the intensity of punishment and its probability of occurrence are high.
4. The lowest degree of suppression occurs when both the intensity of punishment and its probability of occurrence are low.

When the effects of expectancy are factored into the foregoing cases, the following additional predictions are obtained:

5. If the expectation of punishment is matched exactly with the aversive event's actual probability and intensity, no additional suppression will occur.
6. If the expectation of punishment is underestimated in either the direction of probability or intensity, then additional suppression will occur.
7. If the expectation of punishment overestimates the aversive event's probability or intensity, then the degree of suppression controlled by punishment will be correspondingly attenuated.

Direct and Remote Punishment

Punishment is applied in a direct or remote manner, depending on the relative distance of the trainer from the punitive event. During direct punishment, in which the trainer applies punishment to a dog, the trainer becomes part of a punitive stimulus complex. The most common form of direct interactive punishment is corporal (i.e., punishment that is inflicted upon a dog's body). The use of severe corporal punishment is rarely necessary and should be eschewed, except in cases of self-defense against an otherwise uncontrollable aggressor. The routine use of slapping,

hitting, punching, or kicking has no place in professional dog training and should be shunned both on technical as well as humane grounds. Corporal punishment is provocative and may elicit additional aggressive behavior and agonistic tensions, thereby compounding the situation. Such physical punishment may cause the hands or feet to be associated with fear and pain, thus resulting in an increased risk for defensive or preemptive biting whenever dogs are surprised by hands or feet moving quickly toward them. Although the individual delivering such punishment may intimidate a dog sufficiently to suppress immediate retaliation by the dog, other less imposing figures, like children or strangers, may become the victims of redirected aggression. Another significant side effect of interactive corporal punishment is that it may cause dogs to fear and avoid their owners. Although certain forms of interactive punishment may be necessary to establish control and dominance over some dogs, as a general rule direct interactive punishment should be used sparingly and only after other methods have been considered and exhausted. Procedurally, physical punishment should be delivered, when necessary, through the modality of a leash and collar, with hands being reserved for the delivery of prompts and affection or other rewards for compliant behavior.

When punitive intervention is necessary, it is preferable to incorporate a remote strategy. Remote punishment separates the owner's presence from the punitive event. Another preferable aspect of remote punishment is that the event can be arranged so that the unwanted behavior triggers the aversive event. A common form of remote punishment is a startle-producing booby trap. Many behavioral complaints (e.g., destructiveness and digging) can be corrected with a little ingenuity through booby-trap arrangements.

Using Time-out to Modify Behavior

Time-out (TO) is a useful tool for the management of a number of common behavior problems and excesses, especially those driven by strong affiliative motivations, such as attention-seeking and competitive play. The effectiveness of TO depends on a number of procedural constraints: timing, bridging, duration, repetition, provision of a reward-dense training situation, and immediate reinforcement of a suitable alternative behavior to replace the one being suppressed. Besides being effective, TO has relatively few negative side effects compared with other punitive methods commonly used for the control of socially disruptive excesses.

Several biological, psychological, and social factors contribute to TO's effectiveness:

1. TO possesses psychobiological significance for dogs.
2. TO avoids stimulating generalized arousal and related adverse side effects associated with interactive punishment.
3. TO has direct relevance to the underlying motivations (e.g., enhanced social contact and control) driving intrusive social excesses and disruptive competitive behavior.
4. TO temporarily removes the dog from the problem situation, thereby preventing inadvertent reinforcement of the unwanted behavior.
5. TO minimizes competitive interaction between the owner and dog, thus avoiding undesirable escalation of dominance tensions.

Loss of Social Contact

From an early age onward, emotional arousal is likely to occur whenever a dog is left alone, especially if the dog is restricted to an unfamiliar place. During periods of isolation, varying degrees of distress (ranging from worry to panic) are predictably stimulated, often together with intense and persistent efforts to regain social contact. Separation-distress reactions may disrupt bioregulatory functions, as well as trigger a variety of undesirable behavioral manifestations, including distress vocalizations, inappropriate elimination, or destructive behavior. Separation-reactive dogs are quieted only after the lost object of affection is finally restored or they exhaust themselves trying to secure such contact.

These primitive separation-distress reactions reflect the dog's psychobiological need for close contact with other dogs and people with whom the dog has formed a strong attachment.

J. P. Scott, who was the first researcher to describe in detail these motivational aspects of canine social behavior, clearly recognized the potential value of separation-related distress for the control of dog behavior:

> In dogs there is an ever-present desire for the company of familiar places and animals, whether human or canine. A dog will work very hard and undergo much inconvenience and discomfort in order to obtain this goal, and will struggle violently if confined away from familiar places or even if isolated in a familiar one. Not only can we use this motivation to direct a dog's behavior toward what we consider desirable ends, but also we can control its development by choosing the places and individuals to which a puppy is allowed to form primary social attachments. (Scott, 1967:128)

As a result of the dog's innate desire to maintain relatively constant social contact, even a very brief period of isolation can be enough to evoke significant emotional distress. TO is based on the finding that mild separation distress can be contingently applied to control undesirable social excesses.

Loss of Social Control

Besides the dog's need for close social contact, its behavior is also strongly influenced by agonistic motivations and tensions, that is, social control. Playful disruptive excesses are often composed of both attention-seeking and competitive components. TO targets both of these motivations by teaching dogs that certain social impulses and excesses regularly result in an abrupt and annoying temporary loss of social contact and control over the situation. In addition, the directive handling used during TO helps to define and enforce appropriate social boundaries.

Where playful competitive tensions are involved, TO is less likely to generate confusion about an owner's intentions. Besides removing a dog from a potentially reinforcing situation, TO signals unequivocally that the dog must refrain from such inappropriate behavior in the future or risk losing contact and control. In addition, other relevant reinforcers (e.g., affection, treats, and toys) can be contingently offered in exchange for more appropriate behavior, thereby providing dogs with alternative means to establish limited control over the situation. The best way to reform a manipulative and controlling dog is to teach the dog how to secure control over the owner by employing socially acceptable and cooperative behavior.

Loss of Positive Reinforcement

Besides withdrawing social contact and control, TO also removes reward opportunities that might otherwise be available to dogs if they had remained in the training situation. The response-dependent withdrawal or omission of positive reinforcement is a strong form of punishment (negative punishment), especially in contexts providing valuable and frequent reinforcement opportunities. TO as loss of positive reinforcement is aversive, and animals work hard to escape or avoid TO from positive reinforcement (Leitenberg, 1965). In fact, under laboratory conditions, TO compares favorably with shock as a punitive contingency. McMillan (1967), for example, found that animals responded to TO and shock similarly, with a TO of 60 to 90 seconds producing nearly the same level of suppression as a brief shock (30 milliseconds at 1 to 2 mA).

HOW TO USE TIME-OUT

Bridging

The effective use of TO requires that the behavior modifier adhere closely to several procedural constraints. Foremost among these considerations is the need for the TO to be well timed and *bridged* with the occurrence of the unwanted behavior. For TO to be effective, a direct connection must be established and maintained between the occurrence of the target behavior and the TO consequence. This is accomplished by immediately following the unwanted behavior with a conditioned punisher (e.g., "Enough!—

Time-out"), seizing the leash firmly, and posthaste hauling the dog off to the TO room. These closely connected events are necessary to form an adequate connection or bridge between the unwanted behavior and the TO consequence.

The bridging stimulus serves two complementary functions: (1) Bridging explicitly identifies the target behavior responsible for turning on TO. (2) Bridging helps link the occurrence of the target behavior with the delayed TO outcome. The vocal conditioned punisher or bridging stimulus identifies the exact behavior triggering the TO event. This signal is immediately followed by an abrupt upward pressure on the leash that is maintained until the dog reaches the nearby TO room or TO station. Alternatively, a loud continuous tone can be substituted as the bridging stimulus or used in conjunction with a taut leash. The continuous bridging stimulus (the taut leash or tone) helps to connect the emission of the unwanted behavior with the remote TO consequence. Without adequate bridging, the specific target behavior may not be adequately identified and connected with the belated TO. By acting quickly and emphatically, there is a much greater chance of a functional relationship being formed between the occurrence of the unwanted behavior and the TO consequence.

Repetition

Besides timing and bridging, repetition is another vital ingredient influencing the effectiveness of TO. A dog may require several repetitions of TO before a strong connection is established between the unwanted behavior and the TO consequence. An exceptionally persistent behavior may take many repeated TOs before it is possible to reinforce an alternative substitute behavior effectively. Also, training should focus on one specific item at a time, with TO following the unwanted behavior whenever it occurs—at least in the beginning stages. Although TO is most effective when it is presented on a continuous basis, the suppressed target behavior is also more prone to recover (extinction) after punishment on a continuous schedule is withdrawn (Kazdin, 1989). Consequently, it is recommended that TO be initially scheduled on a continuous basis, but once an adequate level of suppression has been achieved, an intermittent schedule of TO is introduced and adjusted—as needed—to maintain low levels of responding (Clark et al., 1973; Calhoun and Lima, 1977; Lehrman et al., 1997). In addition to introducing an intermittent contingency of TO, it is important that desirable behavior be actively prompted and reinforced to facilitate the training process.

Duration

The duration of TO is also important (Kaufman and Baron, 1968). Most dogs respond to repeated 1- or 2-minute TOs, but even shorter periods of 30 seconds can be very effective. Nobbe and colleagues (1980) recommend a 3-minute TO period for punishing aggressive behavior, but this longer TO does not appear to be necessary for most nonaggressive social excesses. Polsky (1989) suggests isolating the dog in a darkened closet and then ignoring the dog for an additional 5 minutes after the TO period is over. These and similar aversive embellishments of the basic procedure (e.g., excessively long TOs lasting from 5 to 10 minutes or more) are unnecessary and should be avoided. Instead of ignoring the dog following TO, the dog should be routinely taken back to the original situation, where an appropriate substitute behavior is prompted and reinforced; or, if the unwanted behavior occurs again, the TO can be reinstated and repeated until a sufficient level of suppression is achieved to permit reinforcement of the selected substitute behavior.

Time-in Positive Reinforcement

The effectiveness of TO also depends on the relative value and frequency of positive reinforcement opportunities yielded by time-in and lost by TO. TO from a reward-dense situation will have a stronger effect over the unwanted target behavior than TO from a punishment-dense situation (Solnick et al., 1977). Consequently, the time-in environment should offer dogs abundant opportunities to obtain positive reinforcement, while

excluding other forms of punishment besides TO (if possible). Emphasis on positive training efforts provide two complementary benefits: (1) positive reinforcement encourages more desirable behavior, and (2) the presence of ongoing positive reinforcement maximizes the punitive effect of TO over the unwanted behavior. If, on the other hand, the time-in environment is reward lean, providing insufficient opportunities for the dog to obtain reinforcement, punishment dense, or (worse still) saturated with uncontrollable aversive contingencies, the net effect of TO will be correspondingly diminished. In cases where excessive interactive punishment is used, the TO period may be *welcomed* by dogs as an opportunity to escape from the situation, possibly reinforcing the unwanted behavior rather than punishing it.

Positive and Negative Feedback

Ideally, the unwanted behavior turning on TO is replaced by an incompatible substitute behavior overlapping the termination of TO. For example, TO is often applied in the case of nuisance barking or excessive activity (e.g., jumping up). During the TO period, dogs typically become more quiet and subdued, behavior that is reinforced because it is associated with release from isolation. Once out of isolation (time-in), a dog's continued social contact depends on its willingness to remain quiet or by exhibiting appropriate social restraint and impulse control. A dog that happens to bark or jump up after being released is immediately timed-out again and released only after calming down. The objective is to train dogs to recognize that being quiet and less demanding results in their being freed from TO, whereas barking or excessive attention seeking results in its reinstatement. The TO is designed to work optimally under such conditions of positive and negative feedback.

Types of Time-out

The TO is arranged so that the target behavior triggers the loss of social contact/control or the withdrawal of positive reinforcement. The two general types of TO used to modify dog behavior are referred to as *exclusionary* and *nonexclusionary* (Foxx, 1982).

Exclusionary Time-out

TO often involves removing dogs from the training situation. The most common way to confine a dog for TO is to place the dog in a lighted bathroom or some other separate room. As the door is closed, the dog's leash is pinched in the doorjamb, leaving just enough slack so that the dog can comfortably stand and sit but not wander about the room. The common practice of punishing a dog by isolating it in a crate is inconsistent with proper crate training and should be avoided. When first exposed to TO, dogs may complain by barking or scratching at the door. Releasing them at this point would reinforce and encourage such undesirable behavior in the future. Sometimes, merely kicking firmly at the base of the door is enough to discourage the behavior. Many dogs require a stronger message, however. Persistent protests are responded to by abruptly opening the door and delivering an assertive reprimand, "Enough!" If necessary, this later procedure is followed by a sharp rattle of a 7-penny shaker can.

A dog that is still complaining after the TO period has elapsed should be ignored and released only after being quiet for at least 10 to 15 seconds. If the dog has remained quiet during the TO, he is praised ("Good boy/girl") through the door, released with reassuring affection, and taken back to the training situation. Additional TOs are applied as needed, until the unwanted behavior is sufficiently weakened to permit instrumental counterconditioning. Exclusionary TOs can also be carried out by confining the dog in the room where the unwanted behavior occurs. This is accomplished by closing the door on the leash as the owner exits the room, leaving the dog restrained on the other side.

Nonexclusionary Time-out

TO sometimes involves withdrawing reinforcement without socially isolating or removing the dog from the training situation. Nonexclusionary TOs are especially effective

in cases where reward training is ongoing. Such TOs can be carried out by simply turning away from the dog, withdrawing the opportunity to earn rewards, or by ignoring the dog. For example, to discourage undesirable behavior occurring during an active training session, a mild version of nonexclusionary TO is carried out by suspending the opportunity to earn rewards for 15 to 30 seconds. This brief *in-training TO* is initiated by saying "time-out" and placing one's hands up and across the chest at shoulder level and turning away from the dog. The overall effect is akin to a "cold shoulder." This particular variation is useful for the control of many mild playful excesses. Another useful nonexclusionary TO involves tying the dog to a doorknob or post so that the dog can comfortably stand and sit but not lay down. A variation of this method is used to apply TO outdoors, where the dog is tethered to a tree or post. The restrained dog is left alone by walking a short distance away.

Time-out and Social Excesses

Many common behavior problems are driven by attention-seeking or playful competitive motivations. Using harsh physical punishment to control such behavior is questionable on a number of grounds but especially because punishing one behavior might simultaneously affect other closely related (but desirable) behaviors belonging to the same functional or motivational class. For instance, physically punishing a greeting excess (e.g., jumping up) will probably suppress the unwanted behavior; however, such aversive procedures could unintentionally dampen a dog's overall willingness to approach or play with family members or visiting guests in more socially acceptable ways, as well. Furthermore, punitive handling during greeting exchanges might encourage the development of an even worse behavior problem, such as submissive urination. Considerations like these warrant the use of techniques that gradually shape alternative patterns of social behavior with positive reinforcement over methods that rely too heavily on interactive punishment.

Some social excesses may be resistant to physical punishment because they are partially or totally shielded from the effects of such punitive treatment. During greetings, for example, and at other times of increased social arousal, affectionate emotions may overshadow the aversive effects of interactive punishment. This effect is clearly evident in the now classic study performed by Fox (1966) in which puppies tended to persevere in their efforts to approach a handler in spite of the delivery of approach-dependent shock. Similarly, Hess (1973) found that young animals would persistently follow and become strongly attached to a punitive imprinting object. This social "immunity" to punishment and pain may be mediated by the endogenous opioid system. Many studies have demonstrated that physical pain evokes the release of modulatory endorphins, morphine-like neuropeptides that produce an analgesic effect. Knowles and coworkers (1987) have shown that dogs exhibit increased tail-wagging and attention-seeking behavior under the influence of naloxone (an opioid antagonist), whereas such affiliative behavior is reduced by the administration of low doses of morphine. Perhaps as a result of the opioid response to pain, some attention-seeking excesses may be maintained by an "addiction" to opioids secreted during punitive interaction with the dog. Further, it has been demonstrated that endorphin activity can be brought under the control of classical conditioning (Watkins and Mayer, 1982), suggesting the additional possibility that the owner's mere presence might elicit a potent opioid cascade, thereby numbing the dog to pending aversive stimulation.

Impulsive social excesses may be potentiated by punitive stimulation failing to reach an effective aversive threshold. Rather than suppressing an unwanted behavior, ineffectual punishment may actually excite increased arousal of the prevailing motivational system, thereby stimulating more—not less—of the target excess. Besides the risk of arousing the dog further, interactive punishment may inadvertently reinforce the unwanted behavior. Again, unless punitive stimulation is sufficiently aversive, it may be overshadowed by incompatible affectionate or playful emotions present at the same time punishment is delivered. After repeated exposures in which pun-

ishment is paired with a pleasurable internal state, the punitive stimulus may be gradually transformed via counterconditioning into an hedonically pleasurable stimulus, thus potentially serving to reinforce the unwanted behavior rather than suppressing it as intended. Punishment under such circumstances may become a discriminative stimulus that evokes considerably more target responding than if it had not be applied at all.

A similar pattern of escalating punishment is very common among dog owners. Fearing to alienate their dog's affections by using harsh methods, owners may choose instead to correct social excesses with an assortment of mild aversives, gradually increasing the level of aversive stimulation over several weeks or months before realizing the futility of their method. In addition, such owners may attempt to reassure and calm the dog after delivering punishment, thereby making punishment a discriminative stimulus for reinforcement. Such interaction between punishment and reinforcement has been demonstrated to exert a tremendous mitigating influence on the effect of punishment (Holz and Azrin, 1961). Consequently, as a combined result of gradual escalation and adverse discrimination effects, aversive stimulation may need to be presented in very intense doses to achieve very modest effects.

Interactive punishment can become a discriminative stimulus (cue) controlling negative attention seeking or aggressive play. Many dogs appear to misinterpret their owner's punitive intentions, viewing their most sincere efforts as little more than a "rough" invitation for play. Attention from the owner is often highly desirable for the dog, regardless of its positive or negative valence, with each form of attention controlling a relatively exclusive set of instrumental behaviors. Positive attention (e.g., affectionate interaction) tends to promote harmonious interaction and strengthen cooperative behavior, whereas negative attention (e.g., ineffectual punishment) tends to reinforce socially disruptive and competitive behavior.

Besides the risk of increased generalized arousal, counterconditioning, and confusion, interactive punishment directed against social excesses may inadvertently facilitate the rise of dominance tensions between an owner and dog. If the owner is not convincing during such contests, the dog may surmise by default that he has won. Such "victories" may be a significant source of reward for some dogs. Establishing one's dominance over another is strongly reinforcing for most animals, including humans, who frequently report experiencing a euphoric sense of well-being or elation after winning a hard-fought battle of wits or brawn. For the subordinate, losing is correspondingly distressing and aversive—just ask any dog owner despondent over a problem of this sort!

Although not necessarily leading to full-blown aggression, playful competitive behavior may be reinforced by a similar elation-mediating mechanism. Competitive dogs often take great delight in vying with and besting their beleaguered owners, sometimes to the point of appearing "silly drunk" on the power derived from such interaction. In dogs predisposed to exhibit aggressive behavior, impulsive competitive interaction with the owner may anticipate more serious dominance-related conflicts appearing later on in life, especially as they reach social maturity.

It should be emphasized that TO is an adjunctive procedure that is most effectively employed in the context of other behavior modification and management activities. Unless fears, frustrative influences, social confusion, impulse-control deficits, and various other contributory factors are reduced or removed, punitive measures are not likely to be lastingly effective. Disruptive behavior is complex and requires careful evaluation and assessment. Treatment includes behavior therapy/modification, formal obedience training, and physiological interventions when indicated by veterinary examination. In this overall context of training, TO should be viewed as an effective "damage control" option rather than a primary leverage point of change.

Negative Practice, Negative Training, and Overcorrection (Positive Practice) Techniques

Negative practice is a behavioral technique in

which an unwanted behavior is decreased by requiring dogs to repeat it over and over again, until its performance becomes aversive in itself. For example, jumping up is a common behavior problem. In addition to appropriately discouraging dogs from such behavior through more conventional means (e.g., TO and counterconditioning a sit or stand response), owners might subject persistent jumpers to a regimen of negative practice. Negative practice in this case would involve having such dogs jump up again and again, perhaps as many as 15 to 20 times per session, or until they begin actively to resist the prompting. At this point, negative practice is abandoned and replaced with negative training. Negative training is a process in which a dog's tendency to resist performing an unwanted behavior is negatively reinforced. For example, in the case of a jumper, the dog is pulled upward but with insufficient force to break the dog's resistance, a resistance that is negatively reinforced by letting go of the leash pressure. The consequence of several such trials of negative training is that a tendency to resist jumping up is encouraged. Negative practice and negative training procedures are very useful for controlling a wide spectrum of persistent behavior problems. As with all aversive techniques, such methods should be used only in a context where reward-based training activities have been proven ineffective as a means to decrease the unwanted behavior.

Another useful punitive tool is *overcorrection* (Foxx and Azrin, 1973; Ollendick and Matson, 1978), a procedure that incorporates positive practice—that is, having a dog repeatedly perform a behavior that is incompatible with the unwanted behavior being suppressed. The usual pattern involves vocally correcting the dog for the infraction and then requiring that the dog repeat some series of related but incompatible behaviors over several minutes. Frequently, the dog must be physically guided through these responses in the beginning. For example, in the case of jumping up, the dog is reprimanded with the vocal cue "Off" and pushed off and prompted to sit. Following this initial correction, the dog is required to perform a series of general exercises like sit/sit-stay and down/down-stay over 3 to 5 minutes (some dogs may require more or less positive practice time). Subsequently, on every occasion that the dog attempts to jump up, the dog is reprimanded and subjected to positive practice. Overcorrection can also be used in cases involving mild aggression problems: dogs that behave aggressively are given a sharp vocal reprimand, followed by a brief TO, and then required to assume a subordinate position while undergoing several minutes of relaxing massage or provided with food treats as long as they remain quiet. TO and overcorrection are highly compatible and work well in conjunction with each other.

Remote-Activated Electronic Collars

A device for delivering remote punishment that has considerable usefulness is the remote-activated electronic collar. Remote electronic stimulation provides a means for delivering a well-timed and measured aversive event. In many ways, it represents an ideal positive punisher, having many potential applications in dog training. In addition to intractable barking problems, dangerous habits such as chasing cars and bicyclists, various predatory behaviors, persistent recall problems, and refractory compulsive habits—all are often responsive to training efforts utilizing an electronic collar. Tortora (1983) has advocated the use of electronic training in the management of certain forms of aggression.

Ideally, the electronic collar should possess several operating features: (1) a variable shock intensity adjustable from the transmitter and collar, (2) a warning and safety tone built into the collar, and (3) reliable operation and range. Little in the dog-behavior literature has been written on the use of shock in dog training or behavioral management, perhaps reflecting the stigma attached to its use, yet limited professional use of such collars is definitely warranted and justified (Vollmer, 1979a, 1979b, 1980; Tortora, 1982, 1983). There are many potential complications in the use of shock for the suppression of behavior, including the possibility of evoking redi-

rected and pain-elicited aggression (Azrin et al., 1967; Polsky, 1998). Notwithstanding the potential for abuse and undesirable side effects, limited professional use of remote electronic collars is definitely warranted and justified. What may not be justifiable is their current widespread use by dog owners with little behavioral background or experience. There is a considerable risk for abuse when such collars are placed into naive and inexperienced hands.

Misuse and Abuse of Punishment

Punishment and other forms of aversive control (e.g., aversive counterconditioning and negative reinforcement) can be humane and effective behavioral tools in the hands of competent trainers, but noncontingent (after the event) punishment and excessive physical punishment or brutalization (e.g., beating, hanging, or kicking) have no legitimate place in the armamentarium of professional trainers. That such methods exist today and are employed in the name of dog training is a blemish on the profession.

Noncontingent Punishment

Perhaps the most frequently misused form of aversive control is noncontingent punishment. Procedures involving such treatment are often recommended for the control of behavior problems that occur while the owner is away from home. Unfortunately, this abuse of punishment has been defended by a number of highly regarded authors (Koehler, 1962; Benjamin, 1985; Evans, 1991). The influence of this popular literature is compounded by many dog owners honestly believing that their dog's misbehavior is motivated by spiteful intentions.

"Spite" and Pseudoguilt

Dog owners who believe that their dog's misbehavior is motivated by *spite* point to the dog's appearance of *guilt* as proof of a premeditated purpose underlying the dog's undesirable behavior. The dog's guilty appearance during homecomings suggests to them that the dog knows and is behaving in a way calculated to somehow injure them. This rationalization provides a basis (at least in their minds) for the delivery of harsh punishment long after the behavior has occurred. Such treatment is targeted against the dog's bad attitude and the dog's need for discipline. The owner's urge to hurt the dog in such cases is rarely constructive but rather the outcome of an angry reaction to the presence of a soiled area or destroyed personal belonging—anger and frustration that is subsequently directed in the form of physical abuse toward the dog.

When such abusive treatment fails (as it inevitably does), the owner may interpret the failure as recalcitrance on the dog's part and point to growing levels of guilt on homecomings as additional evidence of such an interpretation, thereby justifying an ever-escalating cycle of abusive interaction. Konrad Most long ago repudiated this faulty interpretation, arguing that the dog may never know the reasons for punishment but only learn that some modes of behavior result in aversive outcomes:

> It has to be constantly borne in mind that the animal can never learn the reason for a disagreeable experience, but only that certain modes of behavior result in disagreeable experiences. (1910/1955:17)

Later, he stresses, regarding the dog's appearance of guilt,

> The "guilty conscience" is caused simply and solely by the so-called fear inspired by the menacing noises and gestures of the human being. In fact, the dog's "conscience" is quite "clear." Such fear is always aroused in the dog by hostile behavior on the part of its master. For, as a rule, the animal has had it knocked into his memory from puppyhood that hostile human attitudes are accompanied, or quickly followed, by some disagreeable experience. But the cause of fear in the presence of the master is never awareness in the dog of any present, let alone any past, behavior to which the man objected. (1910/1955:72)

Although it is impossible to know for sure, dogs probably do not reflect much on the past or future significance of their behavior. "Every dog," as Hans Tossutti (1942) once noted, "considers his acts as right."

Instead of worrying about the past or future significance of what they do, dogs are content with the here and now, living in a perpetual present where time flows like the Heraclitean river into which "we step and do not step." Although dogs can encode experiences and retrieve memories, they are most likely unable to form conceptual constructs and symbolic representations of events from which to deduce causal inferences about the distant past or future. Consequently, appealing to a canine ability to extrapolate from a present consequence to a past action does not help to explain the dog's appearance of guilt. Although a dog may be able to associate the presence of a destroyed item with the owner's anger, it is unlikely that the culpable action is directly influenced by the owner's disapproval or abusive efforts. Unfortunately, however, the owner reads the dog's guilt as if it was related to a remote action present in the dog's mind at the time of punishment. Dogs do not appear to have such cognitive abilities. To dogs, threats of future punishment are as useless and meaningless as punishment is for long past actions. Actually, most of what we do and value as humans is probably lost on dogs. William James offers a bit of sobering analysis regarding the situation:

> Our dogs, for example, are in our human life but not of it. They witness hourly the outward body of events whose inner meaning cannot, by any possible operation, be revealed to their intelligence—events in which they themselves often play the cardinal part. My terrier bites a teasing boy, for example, and the father demands damages. The dog may be present at every step of the negotiation, and see the money paid, without an inkling of what it all means, without a suspicion that it has anything to do with him; and he never can know in his natural dog's life. (1896/1956:57–58)

The Persistent Belief that Noncontingent Punishment Works

Another factor contributing to the popularity of noncontingent punishment is the appearance that it somehow works. Since noncontingent punishment is often directly associated with the object or area where the offending behavior took place, any appearance of effectiveness is probably due to the influence of aversive counterconditioning. In other words, the ostensible benefit of such treatment is not due to the remote suppression of the unwanted behavior, but rather such methods probably work by indirectly conditioning fear toward the object or location where punishment took place in the past. One of the most repugnant examples of noncontingent punishment in the dog-training literature illustrates this effect:

> If you come home and find your dog has dug a hole, fill the hole brimful of water. With the training collar and leash, bring the dog to the hole and shove his nose into the water; hold him there until he is sure he's drowning. If your dog is of any size, you may get all of the action of a cowboy bull-dogging a steer. Stay with it. I've had elderly ladies who'd had their fill of ruined flower beds dunk some mighty big dogs. A great many dogs will associate this horrible experience with the hole they dug. ... It is not necessary to "catch the dog in the act" in any of the above instances of correction. Be consistent in your corrections and your dog will come to find the smell of freshly dug earth quite repugnant. (Koehler, 1962:200)

Pressing a dog's nose into water is irrelevant to digging per se, but, as the author points out, the terrifying sensation of drowning causes the dog to acquire a repugnance to the smell of soil, to say nothing of how it affects the dog's attitude toward the owner. Instead of suppressing the tendency to dig, chew, or eliminate in the owner's absence, such extreme methods cause the dog to avoid the item or place where aversive stimulation took place. Along with Koehler, Benjamin (1985) and Evans (1991), using much more restrained aversives, also emphasize the need to present evidence or proof to the dog to make the "disciplinary" event effective. Such treatment does nothing to deter destructive behavior or inappropriate elimination, but it may instill a fear of the object, place, or person associated with "punishment."

Although aversive counterconditioning has a useful place in dog training, such variants as the aforementioned method are ill-conceived and excessive. One concern about the method is that dogs may learn to associate aversive stimulation, not only with the

surrounding area or object, but with the abusive owner applying it. Because of this risk, aversive counterconditioning is best carried out through remote means utilizing booby traps and other procedures by which the object or area itself appears to deliver the aversive stimulus. Such methods require comparatively mild aversives, with far less risk of producing side effects, while at the same time promising a much greater likelihood of success.

Interpreting Pseudoguilt

If dogs are unable to connect punishment with the behavior occurring in the remote past, what causes their appearance of guilt? A frequently cited analysis of guilty behavior interprets *guilt* as a ritualized submission display aimed at avoiding noncontingent punishment (Borchelt and Voith, 1985). This theory holds that *pseudoguilt* is maintained by a triadic structure of conditioned associations involving three components: (1) evidence of a destroyed object or soiled area, (2) the presence of the owner, and (3) a history of previous punishment under similar conditions in the past. Many anecdotal reports support this sort of interpretation. For example, it is not uncommon for an adult dog who is kept with a puppy to show guilt when the owner returns home, especially if the puppy happens to eliminate during the owner's absence. It is the adult dog who exhibits guilt, even though the puppy's action was responsible for the offending mess. There are other potential causes of pseudoguilt that ought to be investigated. One possibility is that emotional cues current at the time of the unwanted behavior persist until the occurrence of remote aversive stimulation. These internal emotional cues may subsequently predict pending punishment. Whatever the cause, pseudoguilt is most likely not due to a lingering bad conscience over a past deed.

Negative Side Effects of Noncontingent Punishment

Noncontingent punishment is often harsh and sustained, with the dog often being beaten immediately after homecomings. Most normal dogs are very enthusiastic about greeting their owners after a long separation. The active emotions are intensely affiliative, and the dog naturally seeks reciprocation—that is, the expectant dog anticipates an equally friendly reply. Instead, its affectionate efforts are met with an unexpected and aggressive assault. The result is a collision of violently opposed and conflicted emotions, a situation structurally similar to the procedures used to induce experimental neurosis in the laboratory. As will be seen in the following chapter, from the perspective of experimental neurosis, the collision of opposing and mutually incompatible emotional reactions predispose dogs to develop neurotic conflict. Because of the intensity of the emotions involved, coupled with the inescapable character of the stimulation, the potential for serious side effects is extremely high.

Adult dogs exhibiting separational distress frequently develop a number of persistent behavior problems such as barking, destructive behavior, and inappropriate elimination whenever they are left alone. This group of dogs is at a particularly high risk of becoming the hapless target of abusive and escalating brutalization as part of their "reform." That such treatment is harmful should be obvious, but it is commonly employed on the recommendation of authors such as Koehler (1962), who interpret separation-related behavior as deriving from sullen vengefulness—a condition that must be tortured out of a dog's character through repeated "spankings." This fraudulent view reinforces the popular interpretation of such behavior, which erringly implicates spite as its primary cause, but Koehler takes matters to an all time low in the following useless and cruel prescription for the "revenge piddler":

> For the grown dog who was reliable in the house and then backslides, the method of correction differs somewhat. In this group of "backsliders" we have the "revenge piddlers." This dog protests being alone by messing on the floor, and often in the middle of the bed. The first step of correction is to confine the dog closely in a part of the house when you go away, so that he is constantly reminded of his

> obligation. The fact that he once was reliable in the house is proof that the dog knows right from wrong, and leaves you no other course than to punish him sufficiently to convince him that the satisfaction of his wrong-doing is not worth the consequences. If the punishment is not severe enough, some of these "backsliders" will think they're winning and will continue to mess in the house. An indelible impression can sometimes be made by giving the dog a hard spanking, of long duration, then leaving him tied by the mess he's made so you can come back at twenty-minute intervals and punish him again for the same thing. In most cases, the dog that deliberately does this disagreeable thing cannot be made reliable by the light spanking that some owners seem to think is adequate punishment. It will be better for your dog, as well as the house, if you really pour it on. (1962:196)

There is no reasonable behavioral justification for this form of mental and physical abuse, but, every single day across America, hundreds of frustrated dog owners are carrying out similar rituals of confusion and cruelty in the name of dog training. After several weeks or months of such abusive interaction, besides irreparably damaging the owner-dog relationship, such treatment inevitably results in the elaboration of more serious behavior problems.

The Need for Close Temporal Contiguity

A brief review of basic learning principles will help to underscore the importance of response-dependent punishment. As has already been repeatedly emphasized, learning depends on the timely and regular presentation of relevant stimuli. This holds equally true for both classical and instrumental types of learning. In the case of classical conditioning, the CS (e.g., whistle) must immediately precede the US (e.g., food) for a conditioned association between the CS and US to be established. Similarly, in instrumental learning, reinforcers and punishers must closely follow upon the emission of the target behavior. The behavior-modifying effects of reinforcement and punishment are both significantly diminished to the extent that their delivery is delayed or delivered independently of the occurrence of the target behavior. In the case of punishment, effective use depends on its prompt delivery whenever the unwanted behavior occurs. Under these experimentally established constraints, "punishment" occurring long after the event is a wasted effort that unnecessarily exposes dogs to aversive stimulation. Such interactive punishment serves no purpose, other than providing owners with an outlet to discharge anger and frustration.

Hitting and Slapping: Okay?

The routine hitting and slapping of puppies and dogs are also inappropriate forms of punishment, especially when they are delivered on a noncontingent basis. Sensitive dogs exposed to such treatment may develop a negative expectation about hands moving abruptly or startlingly in their direction. Voith and Borchelt have noted a significant correlation between abusive house-training measures and an increased incidence of fear-related aggression in adult dogs:

> Direct physical punishment from the owner, even if the dog is "caught in the act" can lead to fearful and defensive behaviors. Punishment unrelated to "the act" results in even more-intense defensive reactions to being approached, reached for, or touched by a person. Although dominance aggression is the most commonly diagnosed behavior problem presented to animal behaviorists, fear-induced aggression is probably the most common type of aggression among pet dogs. Fearfully aggressive housedogs almost invariably have a history of difficulties in housetraining and were inappropriately and unpredictably punished by the owners. (1996:176)

Under conditions of heightened distress or even momentary distraction, the startling approach of a child or stranger with outstretched hands may be interpreted as a threat, resulting in a preemptive attack aimed at controlling it. Further, the transition from a smack on the rear or chops to Koehler's method is one of degrees, not kind. Physical sorts of punishment rarely yield lasting suppression of behavior, unless they are delivered strongly. This characteristic often causes the "spanking" to escalate gradually into a peri-

odic beating. Ethical trainers and behaviorists should draw the line firmly and exclude all forms of corporal punishment from routine training, except as might be needed in the case of self-defense.

Finally, uncontrollable painful stimulation occurring under some social circumstances may simultaneously elicit fear and anger as unconditioned responses. Where fear and anger are elicited together by the threat of inescapable pain (e.g., inappropriate physical punishment), the possibility of lasting irritability, vigilance, anxiety, and lowered thresholds for aggression may occur in the presence of the punishing agent. Under the influence of such abusive handling occurring early in a dog's life, fear and anger may become motivationally linked together as a conditioned response to pain or threat of pain and, over the course of the animal's development, "incubate" until the dog reaches maturity, by which time a highly intractable aggression problem may express itself.

Abusive Punishment: The Need for Universal Condemnation

The use of corporal punishment to control dog behavior is very problematical and should be avoided. Not only are such methods dangerous for inexperienced owners to employ, they are probably ineffective (certainly in the sense of lasting and generalized behavioral control) and are fraught with potentially serious side effects. Physical punishment of aggressive behavior can easily result in an escalation of aggression or produce a more severe and difficult problem to control. For example, although an intimidated dog may not dare to threaten or snap at the person applying such abusive treatment, other family members of less social rank or unsuspecting guests may become the victims of redirected attacks or attacks following momentary disinhibition. Further, excessive punishment may suppress vital threat displays, making future attacks more difficult to anticipate and avoid safely. In the long run, such misguided training efforts may produce a much more difficult and dangerous situation to control.

Despite the criticism and growing pressure exerted by leading dog trainers, applied animal behaviorists, and veterinary behaviorists, corporal punishment remains deeply entrenched in the dog-training culture. Some advocates of extreme measures (e.g., beating and hanging) argue that it should be used only as a last resort for the control of incorrigible behavior problems. Many are simply ignorant and do not know any better. A national task force of animal behaviorists, dog trainers, and veterinarians was convened in March 1998 to address such problems by defining humane dog training and to set the groundwork for developing a professional standards and practices document. The efforts of the task force have been enthusiastically received and endorsed by many dog-training, humane, service-dog, and veterinary organizations. It remains to be seen how effective these efforts will be in curtailing abusive practices in dog training.

Although punishment is an important tool for the control of dog behavior, its use should be tempered by informed judgment, ethical restraint, and compassion. Dog trainers and behaviorists alike would do well to follow the spirit of the Hippocratic oath to "do no harm" and to avoid methods that so obviously "do harm" dogs and the human-dog relationship.

General Guidelines for the Use of Punishment

Punishment and other aversive training techniques are complex and require careful assessment and implementation. The following is offered as a general, but by no means exhaustive, set of guidelines for the effective use of punishment.

1. Punishment should be used only after other positive training options have been carefully considered or exhausted.
2. The trainer should never punish out of anger or frustration. Punishment should be used as a constructive training option, not as a means to vent negative emotions. Punishment should be performed with a pronounced sense of moral responsibility and

honest commitment to the dog's well-being and happiness.

3. Punishment delayed for even a second or two after the event should be avoided. Some behavioral authorities have made insupportable claims suggesting that a window of effectiveness for punishment exists ranging from 30 seconds to several hours after the event. The effect of punishment is progressively attenuated with every second elapsing between the emission of the target behavior and its belated application. This so-called delay of punishment gradient fades to nearly zero after a delay of only 30 seconds (Kamin, 1959; Camp et al., 1967). The best suppressive effects result when punishment overlaps the target response.

4. Punishment should occur at the earliest point in the behavioral sequence targeted for suppression. Ideally, punishment should be applied against intentional movements—the weakest and easiest links to break in the behavioral chain of events.

5. An alternative substitute behavior should always be prompted and reinforced immediately after the termination of punishment. Ideally, the behavior emitted with the cessation of punishment should be desirable and incompatible with the target behavior undergoing suppression.

6. Avoid excessively harsh punishers: never hit, kick, slap, hang, or beat a puppy or dog.

7. An antecedent signal or reprimand should be consistently paired with the punitive event. The reprimand will gradually become a conditioned punisher, perhaps, eventually taking the place of actual punishment. In general, training events should be presented in an orderly manner, allowing the dog to achieve a degree of predictive control over their occurrence.

8. Whenever possible, avoid interactive punishment. Many punitive events can be controlled remotely through indirect means and booby traps.

9. Select punishers that are relevant to the underlying motivation driving the unwanted behavior. For example, brief time-outs are best suited to attention-seeking and playful competitive behavior, whereas a physical assertion of control may be more appropriate in situations involving dominance challenges.

10. Select punishers on the basis of their significance to the sensory modality most directly linked to the unwanted behavior being suppressed. For example, in the case of excessive barking, a startling sound can be used. Lunging into the leash is appropriately countered by an opposing leash correction sufficient to break the dog's forward momentum while knocking the dog slightly off balance.

11. Fit the punishment to the dog's temperament and behavior: do not "kill a mosquito with a sledgehammer" and, likewise, do not "attempt to stop an elephant with a squirt gun." A punitive event that is excessively intimidating for one dog may be barely effective or ineffective for another one possessing a bolder temperament and greater determination to persist in the unwanted behavior.

12. The most effective positive reinforcers possess an element of surprise. Likewise, aversive punishment is most effective when it generates a strong startle at the moment of its delivery. The infliction of pain is not a necessary component of effective punishment, but startle is necessary to maximize punitive effects.

13. Punish one behavior at a time. Novice trainers frequently error by attempting to do too much at once. Correcting more than one behavior at a time often results in confusion and inefficient use of training time.

14. Do not escalate punishment incrementally but use a sufficiently strong punisher from the beginning. The gradual escalation of punishment results in its systematic habituation. Such efforts ultimately result in the need to use a more aversive punisher than would have been necessary had a sufficiently strong one been used in the first place.

15. Vary the type of punishment. One punisher may work in one situation but not work as well in another.

16. A punisher that does not work within three to five trials should be reevaluated and possibly abandoned.

17. Make certain that the behavior being punished is not being inadvertently rein-

forced, especially if it tends to recover or resists suppression.

18. Always remember that the target of punishment is the dog's behavior, not the dog.

19. Try to understand the dog's motivation and behavior from a canine point of view. If in doubt about punishing a dog, give the dog the benefit of doubt.

20. Be consistent.

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9

Learning and Behavioral Disturbances

One can conceive in all likelihood that, if these dogs which became ill could look back and tell what they had experienced on that occasion, they would not add a single thing to that which one would conjecture about their condition. All would declare that on every one of the occasions mentioned they were put through a difficult test, a hard situation. Some would report that they felt frequently unable to refrain from doing that which was forbidden and then they felt punished for doing it in one way or another, while others would say that they were totally, or just passively, unable to do what they usually had to do.

I. P. PAVLOV, *Conditioned Reflexes and Psychiatry* (1941)

The studies that are reviewed in this chapter raise serious ethical issues about the treatment of experimental animals. Many of these experiments, as well as others previously cited in this book, obviously caused the animals involved considerable distress and pain. Recent progress in the care and treatment of laboratory animals would make some of these experiments impossible to perform under current rules and ethical constraints. Contemporary experimental psychologists would certainly have a difficult time obtaining formal approval and public funding for the more aversive procedures used by workers in the past investigating experimental neurosis and traumatic aversive learning. Notwithstanding the obvious suffering and sacrifice extracted from the animals used in such study, the information obtained by these studies does provide practical information that may prove beneficial for dogs, both in terms of promoting welfare concerns and saving lives. Although the following accounts may be disturbing for sensitive readers, ignoring such information would only add insult to the already lamentable injury.

LEARNING PROCEEDS most efficiently under circumstances where relevant events occur in a more or less predictable and controllable manner. Unfortunately, these basic requirements of order are not always satisfied. In severe cases, such shortcomings result in long-term disturbances of behavior and learning. Behavioral disturbances range from compulsive disorders and phobias to generalized anxiety and depression. Abnormal behavior is often observed in dogs as the direct result of dysfunctional learning experiences.

EXPERIMENTAL NEUROSIS

A great deal of experimental attention has been focused on the etiology of abnormal behavior and neurosis in animals (Patton, 1951; Broadhurst, 1961). The term *neurosis* is used here in a narrow sense, not to be mistaken for the condition described in human psychiatry, although parallels do exist between human and animal neuroses. To limit confusion, a working definition of neurosis is needed. In the *Oxford Companion to the Mind*, Gregory defines neurosis as a maladaptive habit: "Neurosis is a habit that is either maladaptive in some obvious respect and/or distressing, yet more or less fixed and resistant to modification through the normal process of learning" (1987:549). The value of this definition is its conceptualization of neurotic behavior in terms of habit and learning. It falls short of being a complete definition because it fails to emphasize the role of emotional disturbance in the etiology of neurotic habits. In general, neuroses result from underlying emotional disturbances collectively impacting on various behavioral, cognitive, and somatic systems. Therefore, the definition is supplemented to include a recognition of the emotional aspect of neurotogenesis: *A neurosis is an emotionally maladaptive and persistent habit or compulsion that resists modification through normal processes of learning.*

Neurotic disturbances are most likely to occur in situations where an animal's ability to predict and control the environment is rendered by varying degrees independent of what actually happens (Mineka and Kihlstrom, 1978). Like many human neurotics, neurotic animals seem to be "possessed by" a negative expectation that causes them to "believe" that what they do or intend to do will have little discernible impact on what occurs. In extreme cases, the effect can be described as a generalized state of powerlessness or futility, or what Seligman has called *learned helplessness*. Knowing that neuroses are precipitated by cognitive or behavioral failures to adequately predict and control significant events, it is not surprising to find that most neurotic disorders present comorbidly with chronic *anxiety* (a generalized emotional state associated with inadequate prediction) or *depression* (a generalized emotional state associated with inadequate control).

The laboratory induction of disturbed behavior is referred to as *experimental neurosis.* Most experimental neurosis studies have been based on the prevailing assumption that neurotic behavior disorders are of a learned origin. Several animal models based on this premise have been developed (Keehn, 1986), with the aim of clarifying the etiology and treatment of neurotically disorganized behavior. The discovery of experimental neurosis is credited to Pavlov's laboratory, in particular, to the Russian researchers Yerofeyeva and Shenger-Krestovnikova, who observed that some dogs when confronted with certain experimental arrangements exhibited dramatic disturbances of previously conditioned behavior. The dogs also exhibited a variety of collateral deviations from the norm both inside and outside the experimental setting. Pavlov considered these disturbances to be of a neurotic origin, that is, elaborations of internal conflict arising from the dysfunctional collision of excitatory and inhibitory processes.

The first example of experimental neurosis produced in Pavlov's laboratory was obtained by Yerofeyeva. In this instance, a dog was shocked and then presented with food, which the dog was forced to eat if necessary. The intensity of shock was gradually increased over several conditioning trials, until it was strong enough to cause "severe burning and mechanical destruction of the skin." Following conditioning, the dog showed no signs of defensive behavior or autonomic changes in res-

piration or heart rate, even when stimulated with the maximum level of current. The experimenters observed that the dog simply salivated and approached the food to eat when shock was turned on. This state of affairs persisted for several months, until the site of stimulation was moved to other places on the dog's skin. When the number of sites increased to a certain saturation point, the previously conditioned response to shock drastically changed. The dog now exhibited an explosive defensive reaction whenever and wherever the shock stimulus was delivered. Even electrical stimulation of the original location resulted in uncontrollable defensive behavior, with no sign of appetitive interest or salivation. The conditioned alimentary reflex to shock was permanently lost, and the previously calm dog became extremely agitated and hyperactive.

Pavlov's workers employed many other experimental methods to induce neurosis (Cook, 1939; Kurstin, 1968). The procedures included the following: (1) The repeated presentation of a conditioned stimulus (CS) that simultaneously elicits both an excitatory and a competing inhibitory reflex. Presumably, the effect is a collision of opposing emotional intentions, producing motivational conflict. (2) Difficult discrimination tasks in which similar stimuli control mutually incompatible responses (e.g., the experiment by Shenger-Krestovnikova discussed below). (3) Exceptionally long presentations of conditioned stimuli before being followed by unconditioned stimulus (US) reinforcement of excitatory conditioned reflexes—that is, disturbances produced by overstrain of anticipatory processes. Petrova (Pavlov, 1927/1960), for example, trained two dogs (one tending toward excitability and the other a more inhibited type) to respond to six different stimuli as salivary conditioned stimuli. Initially, the interstimulus interval between the CS and US was very brief, but as training proceeded this interval gradually increased by 5 seconds daily. Disturbances (in the excitable dog) began to appear after 2-minute intervals were reached. Dramatic disturbances of behavior were observed with 3-minute delays between the CS and US. Pavlov writes that the excitable dog "became quite crazy, unceasingly and violently moving all parts of its body, howling, barking, and squealing intolerably. All this was accompanied by an unceasing flow of saliva, so that although the secretion increased during the action of the conditioned stimuli all traces of the delay completely disappear" (1927/1960:294). The more inhibited dog was able to cope with the delay without signs of behavioral disturbance. (4) An abrupt shift from an excitatory stimulus to an inhibitory one and vice versa. (5) Unpredictable expectancy reversals—for example, a CS that had been previously associated with food is followed by shock instead. (6) The occurrence of any intense, unusual, or traumatic stimulation—for example, the effect of the Leningrad flood reported by Pavlov or the laboratory dog fight reported by Gantt (see the following section on post-traumatic stress disorder).

The disturbances produced by the foregoing procedures can be divided into three general categories: (1) disturbances of normal learning abilities (e.g., some previously learned habit is no longer exhibited, loss of conditioned inhibition, or an impairment of an animal's ability to reacquire the lost habit or association); (2) autonomic disturbances (e.g., cardiac, respiratory, sexual, and secretory changes), and excessive emotional displays, like fear and aggression; and (3) elaboration and generalization of unusual behavioral changes, both inside and outside of the experimental context (e.g., increased shyness and aggressiveness toward other dogs and people as well as long-term autonomic disturbances). Hebb (1947) argued that many of these symptoms of neurosis could actually be viewed as adaptive species-typical responses to traumatic stimulation and nervous overstrain. He argued that true neurotic disturbance led to persistent learning deficits (e.g., a failure to perform acquired discriminations).

Shenger-Krestovnikova induced neurotic symptoms by exposing a harnessed dog to a series of difficult visual discriminations. In her famous experiment, she alternately presented the dog with a circle and an ellipse. The shapes were projected onto a screen located directly in front of the dog. The appearance of the circular shape was immedi-

ately followed by the presentation of food. After several trials, the circle became a conditioned excitatory stimulus (CS+) capable of eliciting salivation. Next, the elliptical shape was introduced. On each occasion that the ellipse appeared, food was withheld. Gradually, the ellipse became a conditioned inhibitory stimulus (CS–) predicting the absence of food. As the experiment proceeded, the ellipse was progressively modified, so that it gradually approximated the shape of a circle. At a critical point where the *susceptible* dog could no longer consistently differentiate the circle from the ellipse, it was either seized by hyperactive reactivity or despondency. The response exhibited depended on the dog's temperament and predisposition. Pavlov described the disorganized behavior of a dog exposed to this experimental arrangement:

> After three weeks of work upon this differentiation not only did the discrimination fail to improve, but it became considerably worse, and finally disappeared altogether. At the same time the whole behaviour of the animal underwent an abrupt change. The hitherto quiet dog began to squeal in its stand, kept wriggling about, tore off with its teeth the apparatus for mechanical stimulation of the skin, and bit through the tubes connecting the animal's room with the observer, a behaviour which never happened before. On being taken into the experimental room the dog now barked violently, which was also contrary to its usual custom; in short it presented all the symptoms of a condition of acute neurosis. (1927/1960:291)

A few dogs exhibited cataleptic immobility. This behavior was often associated with the refusal of food and with aggressiveness toward familiar persons with whom the dogs were previously friendly. Some dogs moved from a stupor into a state of furious rage. Others exhibited a cyclic, bipolar alternation of intense excitability followed by pronounced inhibition. Astrup (1965) noted that such symptoms are similar to those exhibited by human psychiatric patients with bipolar mood disorders.

Thomas and DeWald (1977) performed a series of experiments employing Shenger-Krestovnikova's procedure with cats. The cats were exposed to light and tone discrimination tasks in which the CS+ and CS– became progressively similar. They were trained under both classical and instrumental paradigms. Special controls and methods of quantification were also added to obtain more objective data of experimental neurosis. Their results are consistent with the aforementioned results reported by Pavlov, both in terms of dysfunctional learning symptoms (especially nonresponding) and collateral behavioral disturbances:

> All subjects in both paradigms [i.e., classical and instrumental] showed a very similar sequence of collateral behavior concomitant with the interruption of responding. As a rule subjects discontinued responding and suddenly became aggressive and attempted to escape. Many attacked objects within the chamber, such as the house light. The degree of emotionality may be inferred from the urination and defecation that often occurred in the chamber only during the specific periods of nonresponding. A number of animals developed diarrhea after at least two days of experimental neurosis. The initial symptoms, then, may be characterized as severe agitation. However, over a period of several successive days in the apparatus, the agitation abated and generally yielded to depression. Animals sat or lay immobile with their shoulders rigidly hunched in a distinctively depressive posture that is characteristic of experimental neurosis. Some animals crouched as if to urinate and remained in this position for long periods of time. ... Three animals refused food when the food magazine was operated. The other three animals approached the food very lethargically and often waited for several minutes after the food was presented before approaching and eating. (1977:222)

Pavlov found that not all dogs were equally susceptible to develop neurotic symptoms. A dog's degree of vulnerability to neurosis was dependent on its temperament. Pavlov divided dogs into four broad types, two of which he believed were particularly prone to the elaboration of neurotic disturbances. The temperament types that he recognized are (1) *sanguine*: very active, socially demonstrative and flexible; (2) *phlegmatic*: less active, socially retiring and stable; (3) *choleric*: highly unstable, manic, and prone to develop neuroses involving excitatory

processes; and (4) *melancholic*: low activity, socially withdrawn and susceptible to neuroses involving inhibitory processes. Dogs with weak, unbalanced temperaments (choleric and melancholic) were found to be more easily stressed and at greater risk of developing learning and behavior disturbances than sanguine and phlegmatic dogs possessing balanced and flexible temperaments (Fig. 9.1). Pavlov believed that dogs were at an increased risk of developing neuroses during puberty and following castration (Windholz, 1994). Surprisingly, young puppies were found to be the least affected by adverse conditioning. Combining these basic temperament types with Eysenck's introversion (socially withdrawn, reserved, and passive) and extraversion (socially outgoing, impulsive, and active) dimensions (see Gray, 1971) produces a number of interactions of interest for understanding some aspects of dog behavior (Fig. 9.2). Traits on the upper half of Fig. 9.2 show signs of progressive neuroticism, with *dysthymic* (Eysenck's terms) instability affecting melancholic introverts (introverted neuroticism), whereas *hystericopsychopathic* instabilities present in the case of choleric extraverts (extraverted neuroticism) (see Gray, 1971).

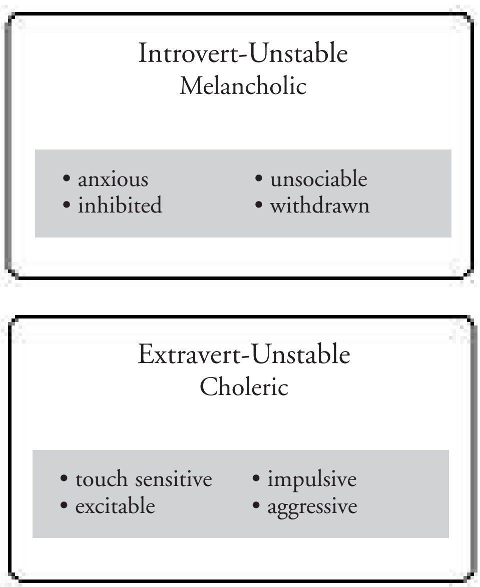

FIG. 9.1. Temperament types and traits most often associated with behavior problems.

Note that sanguine and phlegmatic temperament types combine with introversion and extroversion to form more stable traits.

GANTT: SCHIZOKINESIS, AUTOKINESIS, AND EFFECT OF PERSON

W. Horsley Gantt (1944) viewed Pavlov's discovery of experimental neurosis as a useful animal model for understanding human psychopathology. As a result, he performed a series of longitudinal studies of experimentally induced neurosis in dogs. One of the dogs he studied—Nick—was observed for over 12 years. His methods for inducing neurosis were similar to those used in Pavlov's laboratory. In addition, he studied the effect of strong emotional stimuli on conditioned behavior and the development of postconditioning neurotic sequelae—results that appear to parallel post-traumatic stress disorder (see below). These procedures included presenting intense and startling stimuli (e.g., setting off a loud explosion while the dog was restrained in the experimental harness), social restriction, fighting (both accidental and provoked), and sexual stimulation (a female in estrus was brought into the experimental chamber while conditioning was taking place). Some of the neurotic symptoms observed included anorexia, disorganized behavior, restlessness, abnormal breathing and heart rate patterns, fearfulness (especially toward persons associated with the experiments), elimination disturbances, and abnormal sexual excitement.

Gantt's work has been sharply criticized (Broadhurst, 1961). Although his experimental method may be wanting in scientific rigor and his data inconclusive, his work is nonetheless thought provoking and deserving of careful study. Gantt's general findings can be grouped into three basic categories: schizokinesis, autokinesis, and the effect of person.

Schizokinesis

Gantt has argued that classical conditioning occurs on more than one level at a time, with some conditioning (especially involving fear)

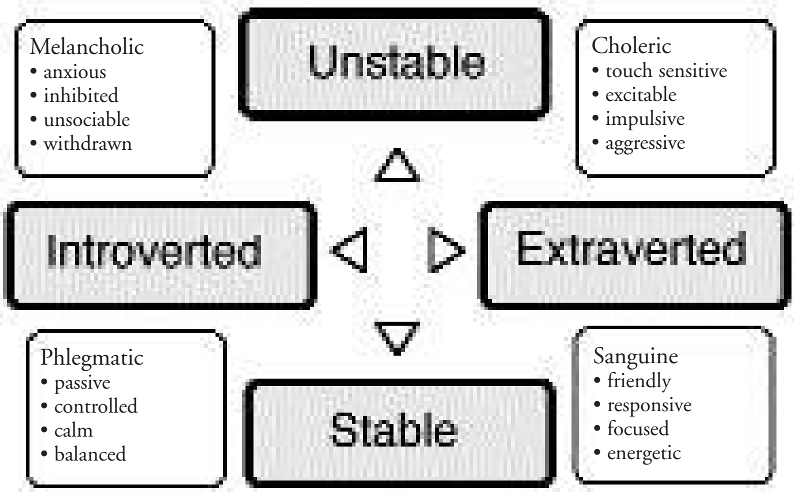

FIG. 9.2. Matrix of temperament types and traits associated with introversion and extraversion. After Pavlov and Eysenck (see Gray, 1971).

affecting remote emotional and endocrine systems in unexpected and sometimes destructive ways. Gantt referred to this cleavage between behavioral and emotional systems as *schizokinesis.* He observed that within these different response systems, respondent learning was acquired and extinguished at different rates. For example, he found that the cardiorespiratory system was particularly responsive to the effects of fear conditioning. Even after a single CS-US trial, a measurable effect could be detected in the dog's heart rate when the CS was presented alone. This pattern of rapid acquisition is in sharp contrast to the sluggish way most alimentary conditioned responses like salivation are acquired. Not only is the cardiorespiratory system sensitive to conditioning, once such conditioning is established it is very resistant to extinction.

These variable rates of acquisition and extinction have a pronounced effect on an animal's general adaptation. The schizokinetic effect sets into motion a physiological expression of psychological conflict and distress. An important corollary to be drawn from this apparent schizokinetic breach between current circumstances and an animal's emotional adaptation to them is that all psychobiological systems are, at any given moment, only partially adapted to the environment and are always homeostatically distressed to some extent. That is, all psychobiological systems (to some degree) are in a state of general disequilibrium, conflict, and distress.

Many fears and persistent anxieties may be interpreted in terms of schizokinesis. The phobic may rationally know that there is nothing to fear, but his or her body is unable to adjust to the known facts. Gantt's observations regarding schizokinesis are especially relevant to the etiology of chronic psychosomatic disorders like high blood pressure and gastric ulcers.

Autokinesis

Not only does neurotic behavior resist extinction (schizokinesis), it also undergoes various self-perpetuating processes. Gantt (1962) observed that—once established—neurotic behavior tended to take on a life of its own, spontaneously elaborating into different forms and gradually recruiting distant behavioral systems. This process of spontaneous elaboration Gantt called *autokinesis.* Frequently, these changes assume a destructive character with a progressive deterioration of the dog's condition (*negative autokinesis*). However, under the influence of beneficial

conditions (e.g., appropriate training and therapy), such elaborations tend to follow a more adaptive course (*positive autokinesis*). The direction of autokinetic change is determined by a combination of temperament factors and environmental influences. For example, Gantt noted that dogs that were housed under the stressful conditions of the laboratory tended to worsen over time, whereas dogs that were retired to the more therapeutic conditions of a country farm tended to improve.

Effect of Person

During social encounters, dogs selectively respond to different people with varying degrees of approach or avoidance. Obviously, many factors, like a dog's temperament and past experiences, have a powerful effect on such social preferences and aversions. Gantt speculated that dogs respond differently, not only as a result of such influences, but also because of other less well-understood factors:

> The effect of person may take two forms: (1) He may act as a signal for some past experience in the same way as any other conditional signal acts. Thus, the person who has mistreated a child or dog may elicit anxiety, fear, or aggression. This is the more evident effect of person. (2) There is another less understood, obscure influence of one individual upon another. Without knowing its mechanism we see the profound effect. Whether it depends upon some undiscovered information-transmission relationship remains to be seen. Here is a vast field for investigation, but adequate methods are presently lacking. (1971:39)

Gantt attempted to quantify the effect of person by measuring and comparing heart and respiration rates under various social conditions. The results of these studies indicate that the mere presence of a passive person in the same room was sufficient to accelerate a dog's heart rate, whereas gentle petting had a decelerating effect. Gantt's observations emphasize the important role of touch and massage in the treatment of behavior problems and for the alleviation of emotional distress.

Of special significance in this context is the role of touch for the reduction of anxiety and other stressful emotional states. Gantt observed that neurotic dogs were particularly sensitive to the calming effect of touch. Nick, whose standing heart rate prior to petting was 167 beats per minute, could be soothed into 97 beats per minute through petting. Three general effects of person are observed among neurotic dogs: (1) extreme agitation and pronounced acceleration of heart rate, (2) a calming effect in which heart rate is decelerated, and (3) an autistic immunity to the effect of person, with little or no change in cardiorespiratory activity—a characteristic exhibited by many of Murphree's fearful pointer dogs (see Chapter 5).

Lynch and McCarthy (1969) performed a study to evaluate the effect of person on a classically conditioned cardiac/motor response to shock. The dogs in the experiment were divided into three groups according to the social circumstances current during testing: person absent, person present, and person present and petting. All animals were exposed to identical aversive conditioning in which a tone CS was paired with shock. Two activities were measured: heart rate and foot flexion. These measurements were taken before, during, and after the presentation of the tone CS. Dogs exposed to the tone while alone or while in the presence of the experimenter (without petting) exhibited the strongest amount of cardiac acceleration (tachycardia) and motor flexion. The dogs exposed to the tone in the presence of the experimenter were slightly less reactive than the dogs tested alone. The group of dogs exposed to the tone CS while being petted exhibited a significant *deceleration* (bradycardia) of heart rate relative to baseline levels taken prior to testing. The petted dogs also exhibited weaker foot-flexion response. An interesting incidental finding was the observation that female dogs exhibited a stronger benefit from petting than did males. In another experiment performed by Gantt, the acceleration of heart rate stimulated by shock was reduced by as much as 50% if a dog was in the presence of a comforting person. In general, petting appears to be an effective way to moderate fear in dogs. Petting is commonly

employed with other counterconditioning stimuli (especially food) during desensitization efforts.

Liddell: The Cornell Experiments

Howard S. Liddell (1954, 1956) studied experimental neurosis in farm animals, especially sheep and goats. Liddell's experiments involved exposing these animals to repeated simple and difficult discrimination tasks involving various stimuli and mild shocks while they were restrained in a Pavlovian frame and harness. The level of shock used by Liddell was very weak (barely perceptible to a finger moistened with salt water) but sufficient to elicit a vigorous unconditioned withdrawal response in the test animals. He utilized various conditioned stimuli ranging from somatic (a rhythmic pressure remotely applied to the skin) to auditory (metronome, bell, buzzer) and visual (dim and bright light) signals.

The typical animal was trained to perform various discrimination tasks involving conditioned stimuli predicting the presence (CS+) or absence (CS–) of shock. The behavior of one of these animals, a sheep named Robert, was described in detail by Liddell in his book *Emotional Hazards in Animals and Man* (1956). Robert had undergone extensive training over 3 years involving simple and difficult discrimination tasks. For example, he had been trained to respond positively to the sound of a buzzer and also to a metronome set to click once per second. The metronome or buzzer was presented 10 seconds before shock was delivered through electrodes attached to the animal's right front leg. Negative conditioned stimuli (those associated with the absence of shock) were also conditioned. Whenever the sound of a bell was presented, for example, it was never followed by shock. This sort of discrimination was easy for the sheep to master. Other negative (inhibitory) conditioned stimuli were also employed that were more difficult for Robert to differentiate from the positive or excitatory conditioned stimuli. This was especially the case with discriminations involving various metronome beats—some rates being associated with shock while others were predictive of its absence. These more difficult discriminations progressively resulted in the elicitation of greater distress and behavioral disturbance. Negative responses were conditioned to metronome rates of 120, 100, 92, 84, 78, and 72 clicks—all of these rates of clicking predicted the absence of impending shock. Robert easily learned to discriminate the metronome set at 60 clicks per minute (positive CS predicting shock) from the metronome set at 120 clicks (predicting the absence of shock). As the rate of clicking neared the positive stimulus, however, the sheep became progressively reactive and disturbed. Exposure to the 72-click rate followed a minute later by the presentation of the positive CS (metronome set at the 60-click rate) resulted in Robert failing to respond appropriately as he had done many hundreds of times in the past to the positive CS. His failure to predict the impending shock resulted in an exaggerated and inappropriate response when shock was finally delivered. Liddell describes this demonstration and the result:

> Exactly one minute after metronome 72 has ceased we sound the metronome at 60 beats per minute and for the first time during the hour Robert fails dramatically in interpreting the signal most familiar to him—the signal, which, since the beginning of his training three years ago, has always meant shock. As the clicking begins at once a second he freezes with forelegs stiffly extended and with signs of respiratory distress. In fact, he duplicates his reaction to the just preceding difficult negative signal, metronome 72. At the end of 10 seconds the sound of metronome 60 is terminated by the usual shock to the right foreleg. However, Robert's reaction to this mild unconditioned stimulus is quite unusual. He leaps violently upward with both forelegs in the air but then immediately resumes a tense pose. (Liddell, 1956:10)

Liddell and his associates studied many different procedures for elaborating neurotic behavior. However, in general, the conditioning procedures he used were for the most part limited to monotonous and repetitious discrimination tasks, typically involving 20 trials a day, 5 days a week, over the course of several months. Their theoretical account of

experimental neurosis emphasized the importance of monotonous repetition and restraint (i.e., loss of control) as the crucial factors involved in the production of neurotic disturbances. They argued that, under conditions of experimental restraint, the mere repeated elicitation of aversive excitatory and inhibitory reflexes was enough to result in the development of experimental neurosis. Further, they found that simply restraining a previously trained sheep in the experimental harness (an apparatus they refer to as a "psychical strait jacket") for an hour session without any stimulus presentation whatsoever was sufficient to evoke evidence of pronounced autonomic and behavioral distress. Loss of control (i.e., exposure to uncontrollable and inescapable events) plays an integral role in the experiments of Liddell, which support the view that control over vital events is of critical importance for the elaboration and maintenance of adaptive behavior and vice versa. Mineka and Kihlstrom discuss the role of control and predictability in Liddell's experiments at length:

> Initially Liddell's group attributed experimental neurosis to a variety of neuroendocrine changes. Later, however, Liddell offered an interpretation very much in accord with our own, noting that the domesticated animal already lives under conditions of considerable restraint—a condition that is exacerbated by the exigencies of the laboratory experiment. Restraint, or loss of control, in either situation alone may be disturbing to the animal, and the two in conjunction are likely to be even more stressful. Liddell often emphasized that laboratory experiments which did not involve restraint of movement (as did the Pavlovian harness), such as insoluble mazes, did not produce experimental neurosis. (1978:265)

Liddell noted that many of the animals he tested exhibited vigorous efforts to break free when they were first placed into the experimental harness. These initial efforts to escape were regularly followed by a sudden lapse into a tense state of resignation. Younger animals accepted exposure to loss of control more readily than older ones. In older animals, the *freedom* reflex appeared to be more persistent and unyielding than in the more compliant and flexible younger ones. Liddell described a 1-year-old billy goat that unremittingly continued to struggle and butt while attached to the training harness, making him useless for experimental purposes. Similarly, Pavlov reported a case involving an outgoing and friendly dog that strongly rebelled against restraint in the harness. However, he gradually overcame the dog's reactivity by reciprocally inhibiting the freedom reflex with the elicitation of another more salient reflex incompatible with continued struggling—eating. Pavlov strongly emphasized the adaptive importance of the freedom reflex:

> It is clear that the freedom reflex is one of the important reflexes, or, if we use a more general term, reactions, of living beings. This reflex has even yet to find its final recognition. In James' writings it is not even enumerated among the special human "instincts." But it is clear that if the animal were not provided with a reflex of protest against boundaries set to its freedom, the smallest obstacle in its path would interfere with the proper fulfillment of its natural functions. (1927/1960:12)

The repeated and inescapable stimulation of escape was considered by Liddell to be the causal locus of neurotic elaboration in his experiments. This viewpoint is consistent with more contemporary theories in which loss of control over significant biological events is considered instrumental in the generation of various behavioral disturbances, like learned helplessness and post-traumatic stress disorder, for example. The animals in Liddell's experiments appear to give up psychologically and thereby predispose themselves to the development of neurotic symptoms and their elaboration under the influence of repeated stimulation of aversive emotional reactions and the chronic habituation of the orienting response. Under conditions of fearful or aversive stimulation where an animal's control over the situation is impeded, and the orienting response habituated through persistent and monotonous elicitation, a growing sense of insecurity and heightened distress occur together with increased arousal and various dysfunctional efforts to adjust. Some of the more pronounced symptoms that he observed in experimentally distressed animals

included hyperirritability, restlessness, insomnia, bizarre postural compulsions, dysfunctional reflex movements, eliminatory disturbances, and a tendency toward self-isolation when with conspecifics.

A study of reactive hypertension in dogs provides some suggestive evidence linking the chronic inhibition of the freedom reflex with increased stress and irritability. Wilhelm and colleagues (1953) found that highly trained and conditioned dogs exhibit a much more extreme blood pressure response to trivial stimulation (entry of a stranger, strange noise in the kennel, and change in routine) than less-well-trained counterparts. The authors speculated along with Liddell that repetitive and monotonous inhibitory training and conditioning is itself stressful and neurotogenic. In a study assessing the effects of stress occurring during guide-dog training, *stress-prone* and *non-stress-prone* guide dogs were evaluated (Vincent and Mitchell, 1996). The researchers found that stress-prone dogs tended to exhibit significantly higher blood pressure readings when compared with non-stress-prone dogs, suggesting that temperament factors play an important role in the physiological expression of stress. These observations raise many questions with regard to training methodology and the various possible side effects resulting from excessive and boring inhibitory conditioning. In addition, the adverse effects of stressful training appear to depend on a dog's temperament and the dog's inclination toward reactive autonomic arousal.

One of the experiments performed by Liddell (1964) generated unusual and dramatic results. The objective of the study was to compare the effect of maternal contact on neurosis-inducing conditioning in twin goats. Siblings at 3 weeks of age were exposed to repeated leg flexion training in the presence of a dimmed-light CS: every 2 minutes, the light in the experimental room was dimmed for 10 seconds, followed by the presentation of mild shock. Twenty such trials were carried out daily over the course of training. The twins were stimulated identically, except one was kept with its mother during testing while the other was left alone.

Several remarkable outcomes resulted from the foregoing procedure. The twin conditioned in the presence of its mother learned to flex its leg as a kind of trick and did not develop the collateral emotional and behavioral disturbances associated with experimental neurosis. In contrast, the yoked twin, undergoing simultaneous conditioning in a separate room, became more reactive and upset as conditioning proceeded. Eventually, the isolated twin became immobile as though restrained in an invisible Pavlovian harness and subsequently exhibited many symptoms of experimental neurosis.

The foregoing experiment is an interesting confirmation of Gantt's effect-of-person theory. The twin conditioned in the presence of its mother was somehow protected from the ill-effects of the training procedure. Liddell observed an unexpected outcome of this series of experiments: all of the isolated twins died within a year (many within a few months) of various diseases, while the twins that were trained in the presence of their mothers survived into adulthood.

Experiments involving dogs performed by Liddell's group were carried out but not very often, as indicated by their lack in the literature. James (1943) utilized a conditioned avoidance response involving strong shock delivered to the foreleg of a German shepherd. The dog's leg had been weighted down so that, to avoid shock, the dog had to lift 30 pounds. The result was "total flight and escape behavior ... signaled in the kennel by the entrance of the experimenter rather than a specific signal in the laboratory (1943:117). After several months of rest, the first CS presented to the dog resulted in such a massive panic reaction that he broke out of the harness restraining him (Broadhurst, 1961). Cook (1939) reported a study by Drabovitch and Weger (1937, in French), who used a somewhat similar method as that described by Liddell. The dogs were trained to flex the left hind leg in response to a bell that was followed by shock. Once the flexion action occurred under the signalization of the bell alone, the experiment was modified in a way reminiscent of Yerofeyeva's experiment discussed earlier. Now, instead of attaching the electrode to the left hind leg, it was attached to the front left leg. The bell was rung repeat-

edly but without the delivery of shock. After three daily experimental sessions involving this arrangement, one of the dogs became quite agitated and on day 4 exhibited continuous convulsions of the left hind leg throughout the testing period.

A second dog involved in their study that had been exposed to leg flexion training over the course of 2 years was given a month-long break. During this period of rest, the dog's cage mate was removed and taken to the laboratory at the normal times he had been tested in the past. When the resting dog was tested after a month, he responded with unexpected and intense withdrawal reactions and convulsions of the left hind foot, a reaction that gradually generalized to the right hind leg as well. The combined convulsions resulted in the dog not being able to stand. Gradually, the dog became reactive as soon as he entered the laboratory situation, exhibiting a high degree of generalized arousal and withdrawal efforts. The researchers speculated that the daily excitement and distress of losing his cage mate may have adversely affected the dog's response to testing by "supercharging" centers controlling conditioned flexion. Although this explanation is not very appealing, the experiment does emphasize the potential inimical effects of separation distress on the elaboration of behavioral disturbances.

Masserman: Motivational Conflict Theory of Neurosis

Jules H. Masserman (1943) devised several methods for inducing neurosis in cats, dogs, and monkeys. These procedures depended on what he called a *principle of uncertainty* and the collision of mutually incompatible appetitive and aversive motivational states. In the prototypical experiment, cats (although dogs were sometimes used as well) were first trained to perform a simple instrumental response to obtain food. The food-deprived animals were individually placed into an experimental compartment that contained at one end a partially closed box with food in it. The food could be easily obtained by prying open the lid. Once the cats had learned how to obtain food, a new contingency was introduced. Access to the box now required that the animals wait for the presentation of a specific combination of light and sound stimuli before approaching. Finally, the cats were trained to turn on the light and sound stimuli by depressing various disk-shaped manipulanda before advancing to the box containing food.

Induction of Neurotic Conflict

After several months of such training, a critical experimental element was introduced. Upon having performed the preliminary requisite responses and just before ingesting the food delivered as reinforcement, the cat was exposed to a blast of compressed air or mild electric shock delivered to its paws. The startled cat immediately retreated from the food box and refused (temporarily) to approach it again. Eventually, however, the cat's fear subsided enough to allow it to approach the container once more. After several "safe" trials, the cat was again exposed to the delivery of unannounced mild shock or air blast. After two to seven trials involving such unpredictable aversive stimulation, the cats began to exhibit various signs of disturbance and abnormal patterns of behavior. These symptoms included an accelerated heart rate, increased blood pressure, piloerection, trembling, irregular breathing and asthma, extreme startle reactivity, irrationally fearful behavior, gastrointestinal disorders, persistent salivation, sexual impotence, persistent diuresis, and epileptic and cataleptic seizures. In addition, some compulsive tendencies also appeared, including persistent restlessness, pacing, and various repetitive behaviors. One of the few dogs exposed to Masserman's procedure appeared to have developed a superstitious behavior pattern as a result:

> Peculiar "compulsions" emerged, such as restless, elliptical pacing or repetitive gestures and mannerisms. One neurotic dog could never approach his food until he had circled it three times to the left and bowed his head before it. Neurotic animals lost their group dominance and became reactively aggressive under frustration. In other relationships they regressed to excessive dependence or various forms of kittenish helplessness. In short, the animals dis-

> played the same stereotypes of anxiety, phobias, hypersensitivity, regression and psychosomatic dysfunctions observed in human patients. (Masserman, 1950:41)

These symptoms were not restricted to the experimental setting only but generalized into "the entire life of the animals and persisted indefinitely" if left untreated.

Masserman believed that the collision of mutually incompatible motivations and the evocation of approach-withdrawal conflict was of central importance to the development of neurotic behavior. However, this interpretation of neurosis has been strongly criticized by Wolpe (1958), whose experiments consisted of two general procedures for producing neurotic disturbances in cats (see Chapter 6). One group of cats was exposed to a series of inescapable shocks after a period of adaptation to the training situation; a second group was exposed to a procedure that was similar to that used by Masserman. Wolpe found a close resemblance in the behavior of both groups of cats regardless of the procedure used, suggesting to him that the motivational conflict hypothesis proposed by Masserman was wrong. According to Wolpe's interpretation, the traumatic presentation of inescapable shock alone is sufficient to produce phobic reactions and the various neurotic sequelae observed by Masserman.

One critical difference between Wolpe's experiments and those of Masserman appears to have been overlooked: the exact timing of shock. In Wolpe's experiment, shock was delivered just before the pellet was reached, whereas, in Masserman's experiment, shock was delivered just as the animal took the food into his mouth. This difference of timing appears to have a pronounced effect on the development of behavioral disturbances in dogs [see below and Lichtenstein (1950)]. To determine the relative significance of these various timing factors and to test the motivational conflict hypothesis, Smart (1965) devised a replication of Masserman's experiment in which shock was delivered at different times relative to the presentation of food. The 30 cats in Smart's experiment were divided into three groups: (1) In the preconsummatory group, shock was delivered while the cat was opening the lid of the food box but before eating the food. (2) In the consummatory group, shock was delivered 1 second after the food was taken in the cat's mouth. (3) In the shock-alone group, shock was delivered at least 30 seconds after any preconsummatory or consummatory behavior. Smart found that the timing of shock added little to the course of behavioral disturbances exhibited by the cats. He concluded that appetitive-aversive conflict plays no significant role in the induction of experimental neurosis, thus supporting Wolpe's contention that aversive stimulation alone is sufficient to produce such behavioral disturbances.

Although Smart's study represents a serious challenge to the conflict hypothesis, Seward (1969) noted that the experiment suffers a procedural shortcoming. The level of shock used by Smart is severe (3.5 mA AC for 1 second); perhaps, argues Seward, "strong enough to suggest that any differences among his groups may well have been hidden by a 'ceiling effect.' Whether an intensity of shock could be found that would make cats neurotic if used as punishment but not if used separately remains to be seen" (1969:433). In addition, it should be noted that the motivational conflict hypothesis is backed by other forms of evidence not addressed by Smart's study. Most significant in this regard is Masserman's finding that behavioral disturbances were significantly attenuated by diminishing the intensity of one of the conflicted elements involved. For example, if a cat was fed (either manually or forcibly tube fed) prior to exposure to the experimental situation, neurotic symptoms were significantly reduced. Lastly, the motivational conflict hypothesis is not entirely falsified by Smart's investigation. He did not demonstrate that internal conflict was entirely absent at the moment of shock in the three groups involved. Various conflict reactions involving the freeze-flight-fight system are a natural and likely response to unpredictable and uncontrollable aversive stimulation regardless of whether it occurs in the presence or absence of appetitive stimulation. Actually, it would appear to be very difficult to control for the influence of motivational conflict in situations involving the presenta-

tion of unpredictable and uncontrollable aversive stimulation. Even though the cats belonging to the shock-alone group were not shocked in the presence of food, they were nonetheless under the influence of emotional and behavioral activities incompatible with shock at the moment of its delivery.

Treatment Procedures

Masserman (1950) employed a variety of treatment strategies to relieve the behavioral disturbances he had produced in cats. Although prolonged rest in a home environment was effective in some animals, the symptoms quickly recovered after the animals returned to the laboratory, even though they were not exposed to additional experimentation. One treatment method that proved effective was the so-called *environmental press*, in which a hungry cat was mechanically pressed toward an especially appetizing food item (salmon pellets spiced with catnip). At the point of highest tension, the cat "suddenly lunged for the food; thereafter they needed less mechanical 'persuasion,' and finally their feeding-inhibition disappeared altogether, carrying other neurotic symptoms with it" (Masserman, 1950:42).

Another method studied involved gentle persuasion and guidance. In this case, the cat was first encouraged to take food from an outstretched hand while outside of the compartment, then to take food while inside the compartment, and so forth, until the cat would once again open the box on its own accord. Through repeated exposure and practice, the food-inhibited cat was gradually persuaded to eat from the food dispenser. This method of therapy appears to have worked especially well with cats possessing a dependent and a trusting attitude toward the experimenter. Masserman argues that the procedure is analogous to *transference* in human psychotherapy, where a patient is encouraged to form a dependent and trusting relationship with a therapist. The therapist in turn navigates the patient through the therapeutic process of conflict resolution until the patient is able to function more effectively on his or her own. This method was particularly effective with some cats that even learned to tolerate the blast of air without exhibiting any apparent signs of fear. In some cases, the air blast appears to have become a positive CS for the presentation of food (Masserman, 1950).

Masserman also studied *modeling* as a method for reducing fear of the feeding apparatus. Neurotic cats were paired with naive counterparts and permitted to observe them eat without experiencing aversive consequences. Initially, the observing cats cowered as food was presented but gradually became more confident and finally advanced toward the food dispenser on their own and ate. Masserman found *vicarious extinction* (as he called it) to be the least reliable of the various treatment strategies that he employed. In conclusion, he recommends an eclectic treatment program in which a combination of various therapeutic procedures is incorporated.

In addition to the aforementioned behavioral techniques, Masserman also explored the use of various pharmacological and psychiatric interventions, like electroshock therapy. Under the influence of alcohol, barbiturates, or narcotics, the cats appeared to be more relaxed and responsive. The neurotic symptoms (at least temporarily) were abated under the influence of such medication. Interestingly, despite a natural aversion toward alcohol, neurotic cats treated with alcohol developed a preference for it over other nonalcoholic drinks—a preference that persisted until the cat's underlying neurotic condition was resolved with behavior therapy. Electroconvulsive shock affected cats in a similar way as drug therapy, except that such treatment also resulted in pronounced and permanent disintegration of behavioral and cognitive functioning and capacity.

Lichtenstein's Experiments

P. E. Lichtenstein (1950) performed a similar series of experiments with dogs and obtained results consistent with those reported by Masserman. In Lichtenstein's experiments, 14 dogs were trained to eat from a box containing pellets of food while restrained in a conditioning harness. Once they had been habituated to this situation and were eating freely,

a 2-second 85-volt AC shock was applied to their forepaws. The dogs were divided into two groups. Group 1 received shock simultaneously with the presentation of food in the pattern of classical conditioning. Group 2 dogs received shock while they were actively eating the food (a punishment paradigm). The criterion for food inhibition was determined by the refusal of food during three sessions of training (60 refused presentations of food). Dogs belonging to group 1 received considerably more shocks (23 to 29) to reach the criterion level, whereas those belonging to group 2 reached a stable food inhibition within one to three shock presentations.

The symptomatology and resulting sequelae exhibited by dogs were very similar to those observed by Masserman in cats. In addition to exhibiting many of the same autonomic symptoms previously listed, other significant symptoms included increased aggression, hyperactivity, and depression. Lichtenstein observed that dogs generally followed one of two distinct patterns: increased excitation or inhibition (catalepsy). Some dogs exhibited tremors and tics—symptoms that are frequently comorbid with compulsive disorders (Leonard et al., 1993). One dog—M88—exhibited an intense activity shift while observing other dogs being fed. M88 also engaged in nearly continuous barking and rapid whirling while confined in his home cage. In general, a noticeable increase in fighting and barking was observed in dogs exposed to the procedure. In addition to increased fighting behavior, increased aggression toward the experimenter was also observed. One dog, a female named F74, reportedly bit the experimenter several times on his hands and wrists on the first day in which her eating response was fully inhibited:

> F74 appeared well adjusted and quiet until the first day of complete failure to eat in the stock. Upon being removed form the stock she bit the experimenter upon the hands and wrists several times and could not be quieted. When removed to her cage she paced in an agitated manner and was aggressive with her cage mates. Although she had not been observed to fight at all previously, there was now scarcely a day when she was not reported to have attacked her cage mates. (Lichtenstein, 1950:23)

In Masserman's experiments, shock appears to have been presented at "the moment of food taking," causing the cat to drop the food from its mouth and retreat from the apparatus. According to Lichtenstein, this difference is significant with regard to the production of anxiety and the experimental inhibition of feeding. As previously discussed, he compared the results of the two procedures and found that the most dramatic and lasting results occurred when shock overlapped the act of eating. His experiments suggest the possible existence of a conflict intensification gradient as choice nears the critical nexus between opposing motivations (Seward, 1969).

Experimental Neurosis and Social Dominance

Masserman and Siever (1944) studied the dynamic influence of experimental neurosis on social dominance and aggressive behavior in cats. In these experiments, several previously trained cats were matched in dyads and evaluated for relative dominance by their ability to compete for and control access to food. The dyads were placed into an experimental chamber with a single bit of food for which they had to compete. As a result of such competition, a winner emerged that controlled future access to food, with the loser deferring on subsequent trials when food was presented. Using this method, three groups of four cats each were organized according to a linear dominance hierarchy. The dominant cat of each group was then exposed to the neurosis-inducing procedure previously discussed. A fourth group was exposed to a separate preparation in which one cat of a paired dyad was trained to manipulate a switch but prevented from obtaining the subsequent reward before the food was eaten by the other cat.

According to Masserman and Siever, hierarchically organized cats rarely engaged in agonistic behavior among themselves over food. Instead, the subordinate simply stayed away while the dominant cat was working the

switches or eating. Aggression was regularly observed only under two conditions: (1) when cats of equal dominance status were paired together (e.g., when the alpha cat of group 1 was paired with the alpha of group 2 or 3), or (2) when the alpha cat was exposed to neurotic conflict and inhibition by aversive inhibitory training of appetitive behavior. After such training, the alpha will usually allow the subordinate to eat but will still attack the subordinate between trials.

The researchers found some interesting results derived from the experimental conditions defined for group 4, in which the trained cat could produce the reward but could not obtain it before the paired conspecific had eaten it. Both cats had been previously trained to operate the switch and were free to play either the role of operator or observer in the experiment. Several variations emerged:

1. In cases where the operator was dominant, the operator would attack the observer and prevent the observer from eating.
2. Some cats developed a cooperative strategy between themselves in which they alternated roles, but this did last beyond 10 to 24 trials, when one of them became parasitic on the other.
3. A "worker-parasite relation" developed in which one cat worked the switch while the other observed and ate. One rather clever cat found that if he depressed the switch several times, he could obtain some food by rushing to the food pan before the observer ate it all.

Although both animals had equal access and opportunity to operate the switch or observe and obtain the reward, the role of operating the switch usually proved obligatory for the more submissive of the two cats. Even though the submissive worker never received food while the dominant cat was present, he nonetheless happily operated the switch for a time as though finding some substitutive satisfaction or intrinsic reward in the operation of the switch itself. Eventually, however, this parasitic relationship broke down, with the submissive cat finally quitting:

> Under such conditions, however, this arrangement broke down, and both animals, even after two days of self-starvation, would lie about the cage deigning to manipulate the signals for the others' benefit. Under these circumstances if one of the animals were removed, the other would, in most instances, proceed promptly to manipulate the switch again for her own feeding; however, some animals seemed to have been so frustrated by the proceeding that a variable amount of individual retraining was necessary before the manipulative pattern was reestablished. (Masserman and Siever, 1944)

Previously acquired instrumental behavior appears to be spontaneously depressed under the influence of stratified social relations in an appetitive-learning situation. This outcome is rather maladaptive when considering that the cats involved could have adopted other more mutually advantageous adjustment strategies. For instance, both of the cats could have simply taken turns operating the switch and eating alternately or the more dominant of the two might have simply taken over both operating the switch and controlling access to food. In the case of appetitive learning, the dominant and submissive cats appear bound to highly specific and rigid roles associated with their status. Under the contingencies of reinforcement described in Masserman's experiment, it is incumbent upon the more submissive animal to emit the requisite instrumental response while the more dominant observer obtains the reward.

Logan (1971) found a similarly dysfunctional outcome in the case of rats trained to avoid or escape shock. A linear dominance hierarchy was determined by pairing rats in various combinations and exposing the dyads to shock. The procedure involved confining paired rats in a small cage and then exposing them to a series of brief shocks until one of them attacked (dominant) and the other submitted (submissive). The rats were then exposed to various training regimens in which some were taught to avoid or escape shock by turning a wheel. Logan reported the following results: (1) If two naive rats (regardless of their status) are paired together in an avoidance-training situation, neither of them is able to learn the required response. (2) If one

of them has been previously trained, then avoidance responding will continue *provided the rat is subordinate.* (3) If both rats have been previously trained to turn the wheel to avoid shock, then the rate of responding is depressed when they are placed together and exposed to usual avoidance signals. (4) Under such circumstances, the submissive rat emits most of the escape-avoidance responses, while the dominant rat initiates most of the aggressive responses elicited by shock.(5) The cooperative participation of paired rats depends on their relative dominance ranking: the more dominant the rat, the more unlikely it will respond during signaled avoidance trials. (6) The initiation of an aggressive behavior and its direction also depend on relative dominance ranking, with the more dominant individual initiating more aggressive interactions toward the more submissive conspecific.

An interesting finding of both studies was a depression of learned behavior occurring when dominant and submissive conspecifics are paired together in the same situation. In Masserman's appetitive context, the dominant cat refused to work in the presence of the submissive cat even though the former was very hungry and capable of performing the requisite response. Similarly, under conditions of avoidance training, the dominant rat, even though well trained and able to perform the requisite avoidance response, refused to do so but instead depended on the more submissive of the dyad, whose ability to avoid shock was compromised by the threats and attacks of the more dominant rat. The result was a vicious circle in which the dominant rat became more and more aggressive toward the subordinate, impeding its ability to avoid shock and thereby stimulating the delivery of more aggression by the more dominant rat:

> The phenomenon of paired-avoidance decrement coupled with aggression is certainly not adaptive. If a dominant S "knows" the avoidance response that is required, it would be reasonable to expect him to "take charge" and protect both itself and the submissive animal. Or even if the submissive S is required to make the response, it might reasonably do it in time to avoid shock rather than waiting to escape it. (Logan, 1971:196)

FRUSTRATION AND NEUROSIS: THE THEORIES OF MAIER AND AMSEL

Maier's Frustrative Theory of Abnormal Fixations and Compulsions

Masserman viewed the causes of neurosis from the perspective of conflict or the evocation of pathological fear and anxiety. He did not examine explicitly the implicit role of frustration. Norman R. F. Maier (1961) performed a series of experiments with rats to explore the effect of frustration on the development of neurotic behavior. Simply stated, Maier's studies involved training rats to perform a visual discrimination between two cards, one having a black circular shape on it and the other a white one. The rats were trained to jump from a platform located several inches away. Jumping to the positive card resulted in food and safety. The negative card, however, was latched in such a way that choosing it would cause the rat to be bumped on the nose and to fall off the apparatus onto a cloth net suspended below. The rats readily learned to discriminate between the positive and negative cards. The next step involved randomly latching the cards so that the rats could no longer make reliable discriminations before jumping. The result was that most rats soon quit jumping. To prompt them to jump, Maier employed various aversive means, like shock or a burst of air, or he directly prodded them with a stick. This resulted in the rats jumping and developing a variety of persistent fixations and preferences toward one position or the other. Even when the discrimination task was returned to its original solvable form, the rats persisted in their abnormal fixations over hundreds of trials.

Maier's experiment placed the rats in a situation of *inescapable* and insoluble conflict. The rats are conflicted between the punishing effect of banging into latched uninformative discrimination cards or receiving aversive stimulation for not jumping (an avoidance-avoidance conflict)—that is, aversive stimulation is inescapable. Some of Maier's results anticipate parallel findings in Seligman's learned-helplessness experiments. Like Seligman's helpless dogs, Maier's rats persisted

over hundreds of trials in their position fixations and failed to learn. The rats appeared unable to abandon their compulsive fixations and to learn alternative, more adaptive escape responses. Also, anticipating Seligman, Maier was able to overcome the effect of inescapable punishment only by forcibly blocking fixated responses and then guiding perseverating rats into performing an easy alternative escape response. Rats learned within 20 trials of directive training to go to an open window for food and safety. Afterward, the positive card was placed in front of the location and the rehabilitated rats quickly learned to associate it with safety regardless of position. This procedure anticipates in many ways the in vivo exposure and response prevention techniques currently used in the treatment of compulsive disorders and phobias.

Unfortunately, as suggestive as Maier's findings are, his experimental design is seriously flawed, possibly confounding frustrative persistence with a negatively reinforced escape response. Under the conditions described by Maier, the fixated pattern might easily be interpreted as the result of a learned escape response evoked by aversive prodding. Maier's experiments appear to have failed to control for this possibility.

Amsel's Frustrative Effects: Response Potentiation and Persistence

Abram Amsel investigated the effects of frustration on behavior. *Frustration* is postulated as an underlying emotional factor that invigorates behavior when it is confronted with obstacles or deterrents blocking the attainment of some desired goal. This general formulation is strikingly similar to Pavlov's aforementioned description of the freedom reflex. The first and foremost response of most animals when confronted with frustration is to press harder toward the thwarted goal. Amsel refers to this drive postulate as *persistence* and the invigoration it causes as the *frustration effect*, which can be readily seen in many situations involving extinction. Typically, a previously successful behavior exposed to extinction procedures is exaggerated in form and repeatedly emitted in an effort to secure reinforcement. Amsel quantified the frustration effect by training rats to run down a long runway at the middle and end of which they would find a goal box containing food. Once the behavior of running to both goal boxes was well established, food was no longer provided at the midway point, requiring that the rats continue along to the end of the runway before being rewarded. Frustrated animals responded by running more quickly than nonfrustrated controls (fed at both sites) (Amsel and Roussel, 1952). These studies demonstrate that behavior is strengthened and invigorated by mild frustration.

Amsel (1971) contrasted resistance to extinction with persistence, stressing that persistence is a more inclusive and general concept. *Persistence* holds equally well for behavior occurring in the presence of frustrative nonreward as it does for behavior enduring after punishment. Persistent behavior occurs despite frustration and pain—but why? Many experiments have demonstrated that partial or intermittent reinforcement renders behavior more resistant to extinction, whereas behavior maintained on a continuous schedule is prone to weaken rapidly when reinforcement is withdrawn. One way to understand this difference is to suppose that conditioned emotional reactions to frustration have become internal cues associated with periodic interruption of regular reinforcement. The animal learns that persisting in the presence of such cues will finally result in final satisfaction. Frustrative internal cues current at the moment of satisfaction are conditioned as secondary reinforcers while antecedent cues become discriminative stimuli for frustrative effort. Over the course of training under partial reinforcement, the aversive hedonic qualities of frustration are either counterconditioned (by being linked with eventual satisfaction) or habituated by repeated evocation during nonreinforced trials. Under these conditions of learning, the stimulus complex (external and internal cues) signaling frustration actually evokes, potentiates, and covertly reinforces frustrated behavior under the maintenance of partial reinforcement.

The persistence of behavior in the presence of pending punishment relies on the de-

velopment of what may aptly be termed *learned courage*. Given the presence of a sufficiently desirable outcome, an animal may endure intense aversive stimulation in order to acquire it. Amsel described experiments by Miller (1960) that found an increased production of persistence or "courage" in rats that had been gradually exposed to shock to obtain a food reward. Following gradual exposure to increasing intensities of shock, preexposed rats displayed an abnormal persistence in the presence of shock over that exhibited by controls. Another situation in which persistence is likely to occur is when the probability of shock is low and the value of the concurrent reward high—that is, when the reward is sufficiently desirable to offset the threat of punishment. The latter formulation results in a cost-benefit calculation in which the risk of responding is compared with the benefits of responding (i.e., the animal appears to gamble).

Persistence is common among dogs especially when considering nuisance behaviors. Many owners inadvertently place undesirable behavior on an intermittent schedule of reinforcement while gradually escalating punitive efforts to suppress it. Begging dogs may frustratively persist in spite of periodic punishment, knowing from previous successes that the owner will eventually cave in to their demanding antics. Frustrative perseveration is frequently observed in behavior motivated by attention seeking (like jumping up and barking). The owner may facilitate such unwanted behavior by periodically allowing it to occur without appropriate punishment. Amsel states the situation very succinctly: "Persistence depends on inconsistent treatment of consistent behavior" (1971:59).

Learned Helplessness

The next major step in the history of experimental neurosis took place in the laboratory of Martin E. P. Seligman, who, with his coworkers, discovered that dogs exposed to traumatic inescapable shock showed signs of neurotic elaboration and disintegration on cognitive, emotional, and motivational levels of organization (Seligman and Maier, 1967; Maier et al., 1969).

Experimental Design and Procedures

Subjects were small dogs of unknown origin that were divided into three groups: escape trained (ET), yoked control (YC), and control (C). The ET group was exposed to escape training involving shock applied to the foot pads of the hind feet while restrained in a Pavlovian hammock. Flat panels located on either side of the dog's head would immediately terminate shock if pressed by side-to-side movement of the dog's head. The YC group, which was simultaneously exposed to identical conditions and stimulation but was not able to escape shock by moving the panels, was exposed to 64 traumatic inescapable shocks occurring every 90 seconds (average) for a duration dependent on the speed and pattern of ET's escape responding, for a total of 226 seconds of shock overall. The ET group could terminate the traumatic shock with the appropriate press of the fitted panels. The C group received no escape training. The following day, all three groups were exposed to escape-avoidance training in the presence of a visual CS (turning off of lights in a conditioning compartment) 10 seconds continuously prior to the delivery of shock. The required avoidance response was jumping over a hurdle (adjusted to the height of the dog's shoulder) into an identical adjacent compartment. A dog that jumped as the light was turned off could avoid shock altogether. All subjects were exposed to 10 trials of escape-avoidance conditioning.

Results

Both the ET and C groups readily learned the shuttle-box avoidance response. The YC (helpless) group, however, exhibited great difficulty in mastering the required behavior. Most of the helpless dogs failed to escape shock by jumping over the barrier when tested. Instead of making an effort to jump, they displayed intense panic reactions followed by impassivity—they simply laid down and whimpered on a wire grid of pulsating shock. As testing proceeded, they made no effort to escape at all. A striking outcome of Seligman's experiment was that inescapable shock had dramatic negative and interfering

effects on postshock learning. Even when helpless dogs occasionally succeeded in jumping over the barrier, they were unable to benefit from these successes on subsequent trials. Besides failing to initiate purposeful efforts to escape shock and learning from their experience, Seligman described several other prominent characteristics associated with learned helplessness: (1) time course (after a single exposure to uncontrollable shock, most dogs recovered within 24 hours but failed to recover after repeated exposure), (2) lowered competitiveness (aggressiveness) and general vitality; (3) development of a negative cognitive set (a belief that nothing can be done, i.e., environmental events are independent of action), and (4) loss of appetite (an outcome also associated with pathological stress).

Seligman theorized that the disruption of escape-avoidance learning and collateral symptoms of helplessness were caused by the affected animal's lack of voluntary control over the traumatic event rather than the event itself. Although trauma is a necessary condition for helplessness to occur, it is causally insufficient in itself to produce the effect. Both ET and helpless dogs received identical treatment, except that the ET dogs were shocked under conditions that they could control. For learned helplessness to occur, the event must be both traumatic and outside the subject's control. Subsequent experiments with a variety of animal species have uniformly supported Seligman's conclusions. The theory has enjoyed widespread acceptance and represents a leading animal model for reactive depression and, more recently, post-traumatic stress disorder (PTSD) (Van der Kolk et al., 1985: Foa et al., 1992).

Immunization and Reversibility

Seligman originally believed that learned helplessness was a transient effect, with recovery occurring within 24 to 48 hours. Two exceptions conflicted with this general observation: (1) dogs receiving multiple sessions of inescapable shock exhibited protracted signs of helplessness, and (2) animals raised under laboratory conditions tended not to recover from the helplessness effect. He speculated that the likely cause for this difference could be attributed to past experiences with controllable trauma. Laboratory-reared dogs were more naive (never having been exposed to escapable traumatic events) than the dogs of "unknown" origins that he had used. The latter group had come from backgrounds that may have included exposure to escapable traumatic handling. To clarify the effects of past exposure to controllable shock, Seligman performed a series of experiments on rats and found that naive adult rats did not recover over time from the effects of inescapable shock. Another group was trained to escape shock and then exposed to inescapable shock. Previous exposure to escapable shock appears to have *immunized* the escape group against the effects of learned helplessness (Seligman, 1975). Helplessness studies on weanling rats exposed to inescapable shock have demonstrated persistent interference effects lasting into adulthood. Weanling rats exposed to the immunizing effect of escapable shock did not exhibit learned helplessness when exposed as adults to inescapable shock. In fact, immunized rats did slightly better on escape-avoidance tasks as adults than did nonshocked controls (Hannum et al., 1976).

Reversing the helplessness effect was possible only by physically forcing the dogs over the shuttle-box barrier. Dogs had to be physically prompted to jump over the barrier for as many as 20 to 50 trials before they began responding on their own. After directive exposure was carried out, helpless dogs began responding like normal ones (Seligman et al., 1968).

Family dogs habitually exposed to unpredictable/uncontrollable punishment are at risk of developing disturbances associated with the learned-helplessness disorder. Traumatic punitive events involving excessive startle reactions or physical pain, which are poorly coordinated with identifiable avoidance cues or response options, meet the operational criteria of inescapable trauma. The occurrence of such interaction is particularly common in cases where punishment takes place long after the event, or when it is applied out of anger. Under these conditions, the owner should be careful not to punish but to think through a plan based on sound

behavioral practice to change the offending behavior.

Another key consideration is to avoid the application of traumatic or highly threatening punishment altogether. Dogs exposed to excessive punishment will never reach their full potential but rather are bound to grow gradually callous to their owner's abusive treatment, appearing not to feel punishment by their lack of responsiveness it. In fact, helpless dogs appear to develop an endorphin-mediated analgesia stimulated by uncontrollable trauma (Drugan et al., 1985). On a cognitive level, helpless dogs have simply learned to take punishment but not to benefit from it. They have fallen victim to a negative learning set that prevents them from responding appropriately under compulsion, perhaps believing that anything they might attempt to do will only fail.

More recently, Sonoda and colleagues (1991) demonstrated that interference effects paralleling those of learned helplessness can be obtained under conditions of uncontrollable appetitive training involving the noncontingent acquisition of food. The interference effects observed adversely affected cross-motivational learning involving shock-escape training. They performed a series of experiments with rats in which three groups were exposed to various conditions of control or loss of control over the acquisition of food. Initially, all of the rats were exposed to a continuous schedule of reinforcement for lever pressing. The rats were then divided into three experimental groups. One group was exposed to additional training under both an FR 5 and then, on the following day, an FR 20 schedule of reinforcement. A second group (the loss-of-controllability group) was yoked to the first group, so that these rats received food on a schedule independently of what they did or did not do with respect to lever pressing. Finally, the third group was given the same number of pellets earned by the first and second groups but en masse in their cage. The various rats were then exposed to a simple escape-training situation (shuttle box) in which they had to jump over a barrier to escape shock. Interestingly, the rats exposed to the loss of controllability contingency proved unable to learn the shuttle-escape task. This result is consistent with the cognitive interference effects exhibited by dogs exposed to uncontrollable shock:

> The important difference between the contingent rats and the loss-of-controllability rats is whether or not a food outcome occurred when no target response was given. Food never occurred for the response-contingent rats when no target response was given, whereas food occurred when the loss-of-controllability rats lost the contingency between a target response and a food outcome. Therefore, the loss-of-controllability rats lost the contingency between a target response and a food outcome. Hence, the interference effects in the present two experiments suggest that the cognition of the contingency between a response and an outcome is an important factor in governing an organism's behavior. (Sonoda et al., 1991:274)

POST-TRAUMATIC STRESS DISORDER

Dogs, like children in our society, are exposed to a high risk of trauma and abusive treatment, predisposing both victims to develop various debilitating behavioral and psychological symptoms. It has been estimated that some 3 million children are annually exposed to significant trauma caused by domestic abuse or violence. Perhaps as many as one-third of these children will eventually require mental health interventions of some form or another as a result of these early experiences (Schwarz and Perry, 1994). A recent estimate by the U.S. Advisory Commission on Child Abuse and Neglect stated that some 2000 children are killed annually through child abuse or neglect in the United States, and that an additional 140,000 are seriously injured. Similar estimates are not available for dogs, but one can assume that untold suffering is also inflicted on dogs by insensitive or brutal family members in equal or greater numbers.

PTSD is precipitated by unpredictable life-threatening trauma that may or may not result in actual physical injury. The ordinary symptoms of the disorder in dogs include some or all of the following: (1) increased sensitivity to startle (hypervigilance) and the exhibition of disproportionate levels of gener-

alized or irrational fear, (2) increased irritability and hyperreactivity, (3) a tendency to behave in impulsive and explosive ways in association with increased affective lability (mood swings), (4) the presence of hyperactivity, (5) a tendency to behave aggressively under minimal provocation, (6) a strong tendency toward social isolation and avoidance, (7) a lack of normal sensitivity to pleasure and pain (anhedonia) or numbing, and (8) depressed mood. These symptoms are usually long-lasting and frequently fail to improve spontaneously over time without intervention.

After the inundation of his laboratory during the Leningrad flood of 1924, Pavlov reported that some of his dogs had developed intense behavioral inhibitions and the loss of conditioned-reflex activity:

> During the terrific storm, amid the breaking of the waves of the increasing water against the walls of the building and the noise of breaking and falling trees, the animals had to be quickly transferred by making them swim in little groups from the kennels into the laboratory, where they were kept on the first floor, all huddled up together indiscriminately. All this produced a very strong and obvious inhibition in all the animals, since there was no fighting or quarrelling among them whatever, otherwise an unusual occurrence when the dogs are kept together. After this experience some of the dogs on their return to the kennels showed no disturbance in their conditioned reflexes. Other dogs—those of the inhibitable type—suffered a functional disturbance of the cortical activities for a very considerable period of time, as could be disclosed by experiments upon their conditioned reflexes. (1927/1960:313)

During testing a week later, one of the traumatized dogs was found to have lost several previously well-conditioned reflexes, appeared abnormally restless, and remained anorexic even after 3 days of food deprivation. Several efforts were made to reverse the adverse effects of the flood, including having an experimenter present with the dog during testing (effect of person)—a procedure that proved very successful. Apparently, the smell of the experimenter had been conditioned as an olfactory cue, since the presence of his clothing (placed out of sight) was sufficient alone to restore the conditioned reflexes. After 47 days of "therapy," normal reflex activity was obtained. However, evidence of long-term deficits was identified:

> A year elapsed after the flood, and during this time we carefully protected the dog from every kind of extraordinary stimulus. Finally in the autumn (of 1925) we were able to get the old reflex, even to the bell. But after the very first time the reflex began gradually to decrease, although it was employed only once a day; and at last it disappeared entirely. At the same time all the remaining reflexes suffered, now temporarily vanishing, now passing into various hypnotic phases ranging between the waking state and sleep although in this dog the latter state was never fully attained. (Pavlov, quoted in Gantt, 1944:29)

Gantt (1944) reported a similarly catastrophic event involving 15 dogs housed in the kennels of his laboratory at Johns Hopkins. The dogs had escaped their kennels and wandered on several floors of the building until being discovered by the night watchman. As a result of the escapade, several of the dogs had suffered various wounds, some as the result of fighting among themselves while other injuries resulted from the watchman's club. The dogs' individual responses to the traumatic event depended on their temperament type, with stable dogs being only slightly affected by the experience. Gantt explicitly recognized a linkage between the breakdown of dogs under traumatic stress and the variable effects of war conditions on soldiers (i.e., *war neuroses*).

More recently, Seligman's learned-helplessness hypothesis has been critically evaluated with respect to its usefulness as an animal model for the study of PTSD (Foa et al., 1992). As just discussed, the experience of unpredictable and uncontrollable traumatic shock is associated with a variety of dysfunctional reactions in dogs: learning deficits, decreased motivation and operant depression, the development of a negative cognitive set, decreased sensitivity to pain, and reduced social status (dominance ranking)—all symptoms found in PTSD.

The behavioral effects of learned helplessness have been traced to underlying noradrenergic pathways stimulated by inescapable trauma. In particular, the locus coeruleus (a

tight grouping of norepinephrine (NE)-producing neurons located in the pons) has a wide distribution of radiating projections extending throughout the nervous system, including the limbic system, cerebral cortex, cerebellum, and hypothalamus (Van der Kolk et al., 1985). The locus coeruleus plays a central role in the modulation of autonomic arousal during freeze, fight, or flight reactions (i.e., the general defensive response to threat). For example, cats exposed to a threatening dog or another cat that has been hypothalamically stimulated to exhibit rage display a twofold to threefold increase in locus coeruleus firing rates, as well as phasic bursts of neuronal discharge that correspond in time to the threats made by the dog or stimulated cat (Levine et al., 1990). NE is the primary neurotransmitter involved in the mediation of global fear and panic reactions. Under stressful conditions of acute or chronic fear, NE turnover is increased and gradually depleted, resulting in a reduced ability to respond adaptively with appropriate escape or avoidance responding to aversive stimulation. Increasing evidence suggests that sensitization of the catecholamine receptors associated with the locus coeruleus results in behavioral changes, like hypervigilance, irritability, anxiety, and increased autonomic reactivity (Schwarz and Perry, 1994). It has been theorized that threat-sensitized neuronal connections render the normally adaptive alarm reaction dysfunctional in two opposing directions, corresponding to the positive and negative symptomatology of PTSD: (1) hypervigilance and generalized activation of the alarm-threat system, and (2) hyporeactivity and avoidance—a general deactivation of normal adaptive responses toward threatening events.

Dogs exhibiting signs of PTSD are frequently described as appearing abused, mistrusting, aloof, unpredictable, aggressive (frequently toward one human sex more than another), hyperreactive, or hyporeactive, and frequently such dogs are very resistant to training. Since PTSD appears to develop as the result of unpredictable and uncontrollable traumatic experiences, it is important that dogs be exposed to training that emphasizes event predictability and control. The successful training of such dogs depends on a program of highly predictable and controllable learning events based on reward-based and affectionate training. In some cases, a combination of forced exposure or graduated counterconditioning may be necessary to reduce maladaptive social or environmental fears and to restore a more confident and outgoing attitude.

CONFLICT AND NEUROSIS

The experimental study and description of conflict was an important area of research for Neal E. Miller. Conflict occurs when incompatible responses compete simultaneously for expression, resulting in varying degrees of behavioral disturbance: "Conflicts can distract, delay, and fatigue the individual and force him to make maladaptive compromise responses. In fact, clinical studies demonstrate that severe conflict is one of the crucial factors in functional disorders of personality" (Miller, 1971:3). According to Miller, behavioral competition between alternative courses of action occurs in two general ways: unstable equilibrium and stable equilibrium. *Unstable equilibrium* is a common state of affairs involving brief hesitation but not much conflict. For example, when forced to choose between two alternatives, such as vanilla or chocolate ice cream, one might momentarily hesitate, but quickly decide to choose one or the other of the flavors depending on one's preference. *Stable equilibrium* is much more problematic in terms of choosing between alternatives. Acting upon one choice may produce effects that either inhibit its completion or excite the expression of the incompatible response competing for expression.

Three basic forms of behavioral conflict have been identified and described in operational terms by Miller:

1. *Approach-avoidance conflict* occurs when the behavioral goal is both attractive and aversive.
2. *Avoidance-avoidance conflict* occurs when behavioral alternatives are both in some way aversive, something akin to being placed "between a rock and a hard place."
3. *Approach-approach conflict* occurs when

two behavioral alternatives are nearly equally attractive and difficult to choose between. In contrast to the other two forms of conflict described, approach-approach conflicts are usually influenced by an unstable equilibrium. As soon as one or the other of the alternatives is approached, the attraction of the other is diminished, thus preventing problematic conflict.

The amount of conflict expressed by an animal depends on the influence of four fundamental factors:

1. *Approach gradient* refers to the tendency of approach behavior to increase as the animal gets closer to the goal.
2. *Avoidance gradient* refers to the tendency of avoidance behavior to intensify as the animal comes into closer proximity to the avoided object.
3. *Approach-avoidance strength differences* refer to the finding that the avoidance gradient tends to be steeper than the approach gradient—that is, the strength of avoidance behavior increases more rapidly than approach as the animal draws near the object of approach or avoidance.
4. *Approach-avoidance drive differences* refer to the effects of variable drive states resulting from increased deprivation or aversive stimulation and their influence on approach-avoidance behavior.

Miller tested these basic principles and various predictions deduced from them by directly measuring the amount of force exerted by rats while exposed to conflict. This was accomplished by running a line and pulley from a measuring device and attaching it to a harness fitted to a rat. This procedural arrangement provided an objective means for quantifying conflict while the rat pulled away from an aversive stimulus or pulled toward an attractive one. Behavioral conflict has also been measured in terms of the disruptive effects it exerts over previously learned behavior, and various interference effects it has over species-typical motivation and behavior patterns have been assessed. Other measures of conflict include physiological changes occurring in the body of the animal, especially those typically associated with biological stress, such as cardiovascular (blood pressure and heart rate) changes. Also, a variety of tests have been devised to measure biological markers released into the blood and other bodily fluids (cerebrospinal fluid, urine, and saliva). Of particular interest in this regard is cortisol alterations and various metabolites resulting from the breakdown of specific neurotransmitters believed to be associated with stress.

Animals conflicted between approach-avoidance options experience varying degrees of stress, depending on the nature of the choices involved. The emotional concomitants associated with such stressful conflict are *anxiety* and *frustration*, both of which can be highly adaptive and useful to animals as sources of motivational impetus to act when under the influence of less than optimal conditions. The commonsense belief that a small amount of anxiety or frustration is conducive to efficient learning and behavioral change has been verified both by laboratory study and by practical experience. However, as has been shown in many of the preceding studies, excessive amounts of anxious or frustrative arousal may impair normal functioning and evoke varying degrees of disturbance and behavioral disorganization. Under natural conditions, conflict is often precipitated by aversive or attractive events that are poorly predicted (anxiety) or uncontrollable (frustration). Numerous studies have demonstrated the debilitating effect of unpredictable and uncontrollable events on the cognitive and behavioral functioning of dogs and other animals. In combination with other sources of stress, such as monotonous and overly restrictive environments (e.g., excessive crate confinement), boredom, insufficient exercise, inadequate sensory stimulation, and other similar adverse influences that place excessive demands on a dog's adaptive capabilities, persistent conflict is a significant source of behavioral maladaptation.

Expectancy: Prediction and Control

A useful operational way to conceptualize anxiety and frustration is to define them in terms of event predictability and controllabil-

ity. According to this interpretation, *anxiety* occurs in situations where an aversive stimulus is impending, and a dog can act to control it, but the exact moment of its occurrence is not well predicted by the available conditioned stimuli. *Frustration* occurs in situations where available outcomes (e.g., various rewards or ways to escape or avoid aversive stimulation) are well predicted but not under an animal's control.

Unpredictability results in training situations in which the CS is as likely to occur contiguously with the US as it is not to occur—that is, the respective occurrences of the US and CS are independent of one another. This relationship can be described in terms of probability (p): p (US/CS is present) = p (US/CS is absent). Uncontrollability occurs in training situations where reinforcement is as likely to occur as it is not, regardless of what the dog does—that is, the occurrence of reinforcement (S^R) is independent of what the animal does (R). Again, this relationship is described in terms of probability: p (S^R/R occurs) = p (S^R/R does not occur). In this case, the response is equally likely to result in the presentation of reinforcement as it is to result in the omission of reinforcement—that is, overall, the available reinforcers occur independently of the response. Seligman and coworkers (1971) described a two-dimensional representation of event unpredictability and uncontrollability in terms of their relative probability (Fig. 9.3). These relationships are graphically illustrated in terms of classical and instrumental *training spaces*. Figure 9.3 shows that the diagonal of each training space represents event independence, whereas the ordinate and abscissa represent varying degrees of probability existing between the occurrence of the represented events.

Mineka and Kihlstrom (1978) argued that the various forms of experimental neurosis previously discussed (Pavlov, Gantt, Masserman, and Liddell) result from the presentation of biologically significant events that occur on an unpredictable and uncontrollable basis. They have stressed the importance of this sort of analysis for the adequate description of anxiety and depression:

> These considerations of predictability and controllability may allow future investigators to spell out some of the possible relationships between anxiety and depression in terms that are more adequately operationalized than those used in the past. Environmental events must in principle be either predictable or unpredictable and either controllable or uncontrollable, generating four possible combinations of predictability and controllability [see the foregoing classical/instrumental interactions]. Moreover, an organism may often not be able to find the correct coping response necessary to gain control; hence, events that are in principle controllable may be perceived as uncontrollable. (1978:269)

Anxiety states that fit these formal criteria can be readily observed in many everyday situations. Anxiety is present to some extent under any set of circumstances in which control is available but the significant event cannot be well predicted—that is, a dog knows what to do and is free to do it but does not know when to do it. Frustrative situations involve circumstances where a dog knows what to do and when to do it but cannot perform the behavior. These definitions of anxiety and frustration are further explored later in this discussion.

Locus of Neurotogenesis

Classical and instrumental learning phenomena are usually treated experimentally as though they functioned independently of one another. In fact, though, most learning involves the participation of both paradigms. This collaborative interaction is particularly evident in the case of attentional behavior. Attention represents a virtually seamless orchestration of classical and instrumental learning mechanisms. An important function of attention is to provide a filtering and organizing interface or gateway between an animal and the surrounding environment. This attentional interface is supported by a sensitive and complex neural substrate that is vulnerable to the influence of adverse negative stimulation impinging on it. As the result of overstrain stemming from excessive or adverse stimulation, this attentional interface

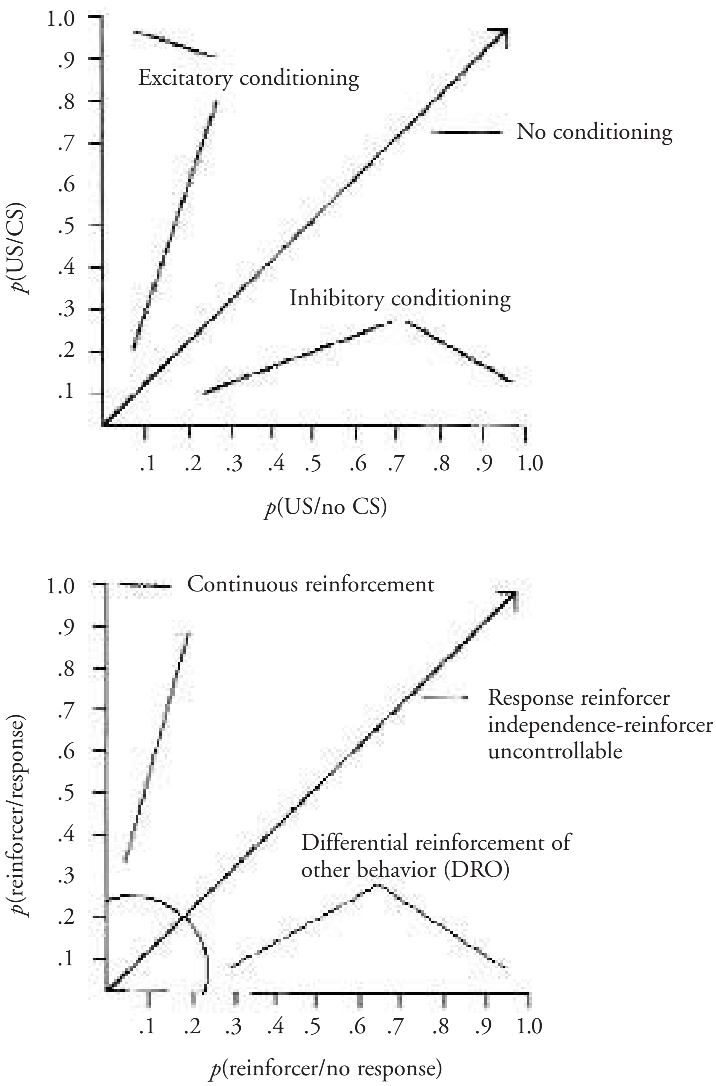

FIG. 9.3. Classical (above) and instrumental (below) contingency "spaces" describing event predictability and controllability. CS, conditioned stimulus; US, unconditioned stimulus. After Seligman et al. (1971).

may break down or become dysfunctional. External influences that strain attention (sometimes to the breaking point) are difficult discrimination tasks, monotonous and repetitive stimuli, and all variety of stressful unpredictable and uncontrollable events.

Attention is here tentatively proposed as the local site of disturbance in neurotic breakdown. Unfortunately, experimental research in this area is seriously lacking, but many findings—for example, the experiments of Broadbent (1958)—support the view that attentional activities are susceptible to adverse influences. An attentional locus of neurotogenesis is implicated by many of the characteristics of experimental neurosis, particularly the failure of an animal to perform previously learned discriminations. Clearly, without the

ability to focus attention, select relevant information, and filter out irrelevant stimulation, an animal is rendered a helpless victim to the flux of chaotic events surrounding him.

Many psychiatric conditions appear to reflect an underlying defective attentional mechanism. In the case of schizophrenia, for example, patients appear unable to select and filter out relevant from irrelevant stimuli or to focus attention normally. The result is gross disorganization of behavior and cognition. Many theorists have viewed attentional disturbances as the core deficit in schizophrenia (Cohen and O'Donnell, 1993). Evidence of attentional deficits is frequently reported in the case of affective disorders like major depression and mania—symptoms that parallel in many ways the inhibitory and excitatory excesses exhibited by animals with behavioral disturbances induced experimentally. Interesting in this regard is the finding that patients suffering major depression do not find situations and stimuli associated with past reinforcement rewarding as they may have in the past. This is also a common feature of experimental neurosis in which hungry dogs or cats will refuse food, display generalized "negativism," and fall into unproductive cataleptic states.

In the case of experimental neurosis, the normally adaptive attentional and response-organizing mechanisms (impulse control) appear to be taxed beyond functional limits by overstrain or disorganized stimulation. According to this theory, the disruption of attentional mechanisms interrupts the normal chain of events that move from sensory stimulation to choice/response-organizing functions serving purposive behavior (i.e., the inventory of classical and instrumental behavioral possibilities). The emotional and behavioral result of neurotic breakdown (i.e., the failure to predict and control significant events) is a variety of affective disorders (especially those involving anxiety and depression), cognitive dysfunctions, and the appearance of disorganized and maladaptive behavior. These debilitating symptoms in turn further impact and adversely influence attentional functions.

Understanding how the absence of predictability and control impacts on behavior requires some consideration of the choice-making or impulse-control process. All learning involves making choices and inhibiting others, whether in the case of complex decisions or primitive attentional preferences—choices are made. At the most primitive level, this ability to choose takes the form of choices between responding and not responding (i.e., between inhibition and excitation). The way choices are made differs significantly between classical and instrumental learning paradigms. In the case of classical conditioning, choices are made with regard to attending to specific stimuli and contextual cues rather than others. This selective attention is determined by the comparative significance of the available stimuli and the animal's current motivational state or disposition to learn (Broadbent, 1958). Such attentional choices require the participation of various relevant cognitive functions, including various expectancies and interests (motivational factors), vigilance, and sustained searching activities operating on the external and internal environment.

Instrumental choices, on the other hand, take place according to general volitional rules and hedonic preferences for available outcomes. Obviously, classical and instrumental learning work together; in fact, as just noted, it is hard (or perhaps not possible at all) to differentiate the two learning orientations on the level of attention and choice. Instrumental choices are motivated by a drive to secure and control preferred outcomes, that is, the approach-acquisition of positive events (e.g., affection, food, and play) or the escape-avoidance of aversive ones (e.g., rejection, withdrawal of food, and isolation).

Under optimal conditions, classical and instrumental adjustments supply a progressive sense of security and regularity between an animal's needs of survival and the environment's ability to provide for them. This is accomplished (in part) by an animal's ability to predict and control the occurrence of significant events. Under stressful and neurotogenetic circumstances, such control is rendered independent of an animal's volition and ability. As a result, dogs might choose to escape

from the uncontrollable situation and search for one more conducive to their needs. If all of their efforts to escape are blocked, or if their efforts only result in equally uncontrollable alternatives, then the situation becomes both uncontrollable and inescapable. This outcome may ensue even in situations where productive (i.e., controllable) alternatives exist, but an animal is unable to perceive them as such. Such loss of instrumental control is initially associated with increased levels of frustration and even more determined efforts to gain control over the difficult situation. If the occurrence of significant events still remains independent of the dog's intensified efforts, then various degrees of perseveration, regression, or frustration-motivated aggression may be exhibited. Under extreme circumstances involving aversive stimulation occurring in uncontrollable/inescapable situations, the result may include regressive fixations (Maier) or helplessness (Seligman).

Locus of Control and Self-Efficacy

Two areas of behavioral cognitive research that have some potential bearing on this aspect of neurotogenesis are locus of control (internal versus external control) expectancies proposed by Rotter (1966, 1975) and the self-efficacy expectancies postulated by Bandura (1977). Although both theories were originally articulated in terms of human learning and reinforcement theory, the researchers' findings are relevant to animal learners as well. According to Rotter's theory, the effectiveness of reinforcement depends to some extent on the organism's perception of a causal connection or contingency between its behavior and the occurrence of the reinforcing event—that is, animals must perceive that they somehow control the reinforcing event in order for it to be fully effective as a reinforcer.

But it is possible that an animal might receive regular reinforcement as the result of the emission of some behavior but not *recognize* a causal contingency between the two events—is such recognition of control over reinforcement necessary for instrumental learning to take place? That is, does the pigeon need to *know* that its key pecking controls the delivery of grain. Also, consider the situation where the contingency of reinforcement is confused or mistaken. In this case, the animal correctly believes that some behavior or other that it emits is controlling the delivery of reinforcement, but, in fact, has wrongly identified which one. Can one legitimately say that the organism controls the occurrence of reinforcement in such cases or is this a case of "deluded" behavior? According to Rotter's theory, it is not enough for the behavior to be followed by reinforcement in the traditional sense of a simple *stamping-in* process; in addition, the animal must *perceive* the existence of a causal relationship between its behavior and the occurrence of reinforcement. Under natural conditions, these sorts of dilemma are largely mitigated by the centrally motivated and intentional character of learning in which the animal strives to control vital events like the acquisition of food and the escape-avoidance of danger.

Rotter argues that learners (*externals*) who perceive the presentation of reinforcement as resulting from forces outside of their control may not perceive their efforts (even when successful) as actually controlling reinforcement but rather attribute their success to external factors (e.g., the trainer's fancy). In contrast, learners who perceive that their efforts are instrumental in the obtainment of reinforcement will be more likely to feel in control of the occurrence of reinforcement and be less likely, therefore, to conclude prematurely that some difficult but, nonetheless, controllable situation is uncontrollable. Such individuals may be less prone to develop a variety of maladaptive disturbances. In addition, it is reasonable to assume that *internals* would be more resistant to the aversive effects of unpredictable and uncontrollable stimulation than *externals*. Further, animals guided by expectancies derived from internal control—that is, perceiving the occurrence of reinforcement as depending on their own efforts—will likely possess a stronger general belief or expectancy that their efforts will eventually be successful in controlling a difficult situation, while an externally driven counterpart may just give up.

Bandura's concept of self-efficacy is of some value in terms of this general problem.

Bandura defines *self-efficacy* as an expectation or "conviction that one can successfully execute the behavior required" (1977:193) to obtain a desired outcome regardless of whether or not the person is actually able to perform the necessary activity. The self-efficacy theory assumes that environmental events affect behavior indirectly via the mediating agency of efficacy expectations (Fig. 9.4). These efficacy expectations are influenced by a wide range of factors, including the success or failure of past learning experiences (i.e., outcome expectancies) and physiological states. If Bandura's self-efficacy theory is correct, then some procedure or other may be devised to *immunize* the organism against the debilitating effects of uncontrollable events by training it to believe that its efforts will eventually succeed in spite of the most adverse circumstances.

A dog's expectations regarding its abilities to control significant events are affected by a variety of factors, including its past training history. Dogs that have been relatively successful as learners will be more likely to interpret training situations as being predictable and controllable. This disposition to see things as predictable and controllable (or vice versa in the negative case) is an outcome of what Harlow (1949) has termed a *learning set* or, more specifically, a higher-order expectancy about future learning events. Such positive generalized expectancies are most likely to develop under the influence of highly controlled and formal training situations such as obedience training where the

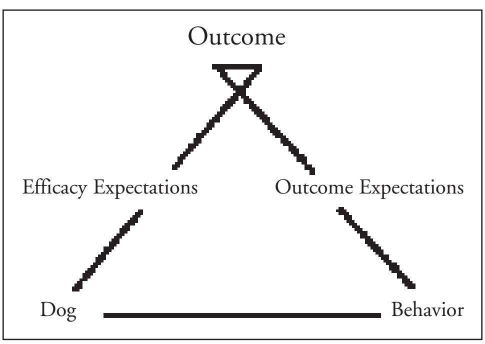

FIG. 9.4. Efficacy and outcome expectations provide complementary influences on learning.

contingencies between stimulus, response, and reinforcement are highly defined and reliable.

(*Please note that henceforth the terms* classical *and* instrumental *are often replaced with the synonyms* respondent *and* operant *in order to improve readability, and with no other purpose intended.)*

Defining Insolvable Conflict

The foregoing discussion provides a framework for developing a formal and functional definition of insolvable conflict. This is an important task, since conflict is crucial to many contemporary models of maladaptive behavior. Although the term *insolvable conflict* is frequently used, its operational definition is rather too vague to be of much use as a scientific term. It is my contention that insolvable conflict and maladaptation are elaborated from the attentional collision of unpredictable and uncontrollable events. Mere isolated respondent unpredictability (anxiety) or isolated instrumental uncontrollability (frustration) are not independently sufficient to produce insolvable conflict and to disrupt attentional organization. Insolvable conflict occurs only in cases where intense levels of respondent anxiety collide with equally intense levels of instrumental frustration, thus overstraining normal attentional and choice-making activities and causing them to become progressively disorganized and dysfunctional.

Within the general framework just outlined, classical and instrumental learning activities interact within a matrix of event predictability/unpredictability (P/−P) and outcome controllability/uncontrollability (C/−C). These interactive axes form two continua: one between anxiety and frustration and another between elation (optimism) and depression (helplessness) (Fig. 9.5). Under normal conditions in which classical and instrumental functions operate smoothly, the locus of activities rests somewhere in the center of these opposing continua, resulting in adaptive behavior and homeostatic adjustment.

These two primary classical and instrument axes cross and divide the matrix into

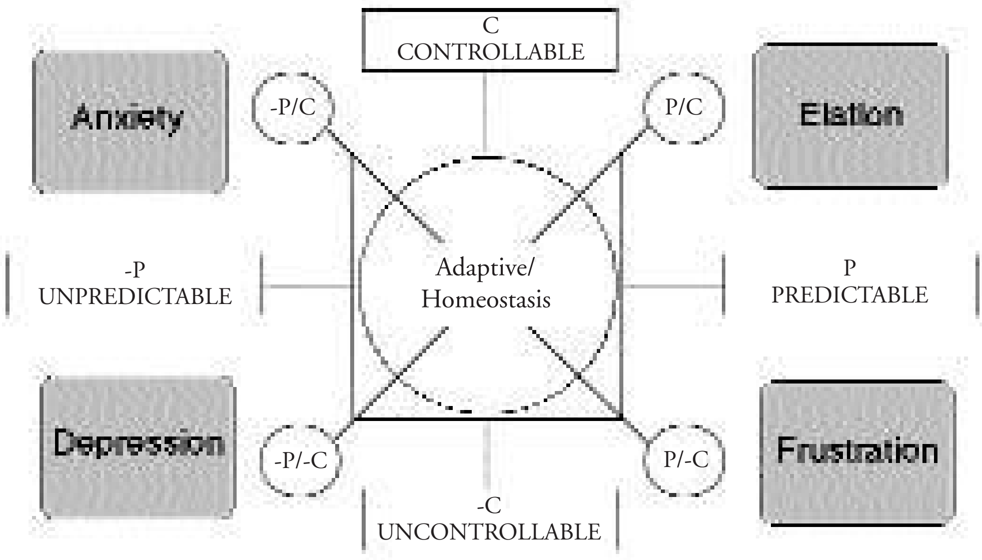

FIG. 9.5. Problematical or insolvable conflict occurs in one of two general ways: (1) when events are highly predictable but not adequately under the animal's control when they happen to occur (P/C–), or (2) when the animal has a high degree of control over the event but cannot predict when it is going to happen ((P/C). When respondent and operant events are either both unpredictable and uncontrollable (–P/–C) or highly predictable and controllable (P/C), the result is helplessness, on the one hand, and elated confidence, on the other. Neither helplessness nor elated confidence is associated with conflict. Functional disturbances corresponding to extroverted neuroticism (see above) occur in the anxiety-elation-frustration half of the matrix, whereas disturbances associated with introverted neuroticism occur in the half of the matrix bounded by anxiety-depression-frustration. Under normal conditions, all four of the above influences (anxiety, elation, depression, and frustration) contribute constructively to an animal's adaptation and homeostatic equilibrium (central area).

two equal sides—one side designated controllable and predictable, and the other designated unpredictable and uncontrollable. Four respondent-operant interactions are possible between predictability (P)/unpredictability (–P) and controllability (C)/uncontrollability (–C):

1. –P/C (unpredictable but controllable) — Anxiety
2. P/C (both predictable and controllable) — Elation/optimism
3. –P/–C (both unpredictable and uncontrollable) — Depression/helplessness
4. P/–C (predictable but uncontrollable) — Frustration

Note that the respondent-operant axis involving anxiety and frustration runs in a direction in which predictability improves as control declines. One would predict from this model that anxiety (–P/C) is most intense when the event is highly controllable but its occurrence unpredictable. Further, maximal frustration (P/–C) occurs when the event is highly predictable, but uncontrollable. The respondent-operant axis between elation (P/C) and depression (–P/–C) promotes optimism on the one hand and helplessness on the other. Optimism occurs if the event is both highly predictable and controllable, whereas helplessness follows if the event is both unpredictable and uncontrollable. In the case of the elation/depression axis, elation emerges as an outcome of the reciprocal improvement of predictability and control as a unit. In contrast, depression is directly related to the reciprocal decline of predictability and control as a unit.

Figure 9.6 diagrammatically represents the necessary respondent-operant components required to generate problematical or insolvable

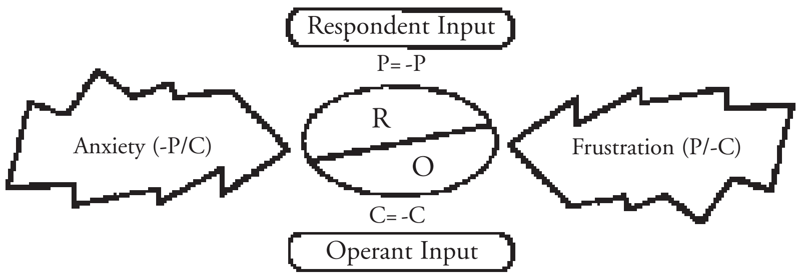

FIG. 9.6. Diagram illustrating the respondent/operant interactions required to produce problematical or insolvable conflict. Note that both operant and respondent influences produce conflict around a shared axis. Conflict is a composite of anxiety (respondent contribution) and frustration (operant contribution).

conflict. Notice that the respondent input is as unpredictive as it is predictive (P = −P). Likewise, the operant output is equally likely to control the event as it is not to control it (C = −C). This situation represents a true insolvable conflict because neither a choice based on respondent predictability nor a choice based on instrumental probabilities will succeed in resolving the dilemma. Under conditions of intense conflict with the arousal of fright-flight-fight mechanisms or exposure to strong conflicting approach-avoidance emotions, predisposed and genetically prepared dogs may experience a neurotic disturbance potentially capable of disabling attentional functions and the entire respondent-operant system. It should be kept in mind from the foregoing model that conflict takes place along a shared axis compounded of both respondent and operant components.

In the case of the respondent-operant axis between elation (optimism) and depression (helplessness), a number of interesting and paradoxical predictions can be made. When a dog is exposed to a pattern of unpredictable and uncontrollable events (−P/−C), the conditioned outcome is depression or helplessness. Having been reduced to a helpless state and then exposed to stimulus events and response outcomes occurring on a highly predictable and controllable basis, the model predicts that insolvable conflict will ensue—that is, the animal will not know what to do. On the surface, this outcome may seem paradoxical and unlikely, yet there is a great deal of experimental support for it in the literature of learned helplessness. After exposure to inescapable-uncontrollable traumatic shock, helpless dogs exhibit a wide range of post-traumatic cognitive and behavioral deficits. For instance, if such dogs are consequently exposed to controllable training situations, most of them fail to learn even simple avoidance responses—responses that would have been very easy for them to learn prior to the helplessness-inducing trauma. Helpless dogs appear paralyzed, requiring direct and forceful physical prompting to escape the shock; left on their own, such dogs often just sit down and stoically accept the pain. The net result of helplessness is a collision of incompatible expectancies resulting in insolvable conflict precipitating various degrees of dysfunction within both respondent and instrumental systems.

The foregoing model also predicts conflict when dogs are exposed to a learning history in which stimulus events have been uniformly predictable and controllable. Dogs exposed to such contingencies of optimism (P/C), when subsequently exposed to uncontrollable and unpredictable conditions, should also fall victim to insolvable conflict. One might intuitively predict that such confident dogs, having known nothing but behavioral success, would go on working at the problem and only quit after expending a great deal of persistent effort and having tested out and exhausted every option. The model predicts instead that certain dogs, especially under the pressure of traumatic or intense emotional arousal, will exhibit strong signs of internal conflict and be far less flexible than dogs exposed to a more natural envi-

ronment of probabilities. The occurrence of such conflict may be obtainable only under carefully controlled conditions, but the potential detriment of either extreme should be kept in mind when developing a training system or rearing practice.

The foregoing discussion underscores the importance of predictable and controllable environmental stimulation for the attainment of healthy emotional and behavioral development. In the absence of orderly information, attentional abilities and learning become progressively dysfunctional and behavior inevitably disorganized. Further, it is evident that various debilitating cognitive, emotional, and somatic effects are evoked by the perception that significant environmental events are unpredictable and uncontrollable. Stimulus events that are unusually intense or traumatic, monotonously repetitive, long enduring, or poorly differentiated from other stimuli evoking opposing responses—all of these sorts of stimuli are productive of stress and potentially result in the elaboration of behavioral disturbances and learning disorders. However, provocative events that are unanticipated (i.e., unpredictable) are particularly prone to produce a biological stress reaction. Beerda and colleagues (1998), for example, tested dogs under a variety of stress-producing conditions, using noxious stimulation. They found that saliva cortisol levels (a sensitive indicator of stress) became elevated only when noxious stimulation (e.g., intermittent sound blasts, shock, a falling bag, opening an umbrella, or physical restraint) was presented on an unpredictable basis. Noxious stimulation that was presented in a predictable fashion still caused the dogs tested to become restless, cower, and shake, but the stimulation did not induce a cortisol stress response.

Pavlov placed tremendous importance on the role of conflict and emotional distress in the development of neuroses. The studies under his supervision demonstrated the importance of clearly defined CS events and the need for a matching correspondence between a dog's moment-to-moment motivational state and the behavioral demands placed upon it. Successful adaptation depends on the development of a fluid correspondence or interface between an animal's expectations about the environment and the confirmation of these expectancies—that is, the acquisition of reliable information about what will occur and knowing what to do (and how to do it) just in case such and such occurs. These experiences result in dogs becoming progressively attuned and responsive to the social and physical environment's demands and pressures without experiencing undue distress, anxiety, or frustration. According to Pavlov, the habitual production of stressful conflict contributes a large measure to the etiology of behavioral disorders in humans and animals, especially in animals prone to neurotic elaboration [e.g., those possessing highly excitable (choleric) or inhibitable (melancholic) temperaments].

These observations underscore the importance of providing dogs with adequate instrumental control over significant events, as well as the inherent dangers of situations in which such control (and predictability) is compromised. Such situations may produce excessive and pathological demands upon dogs to adjust, precipitating the expression of disorganized and dysfunctional behavior. These effects are especially deleterious in the case of overly excitable dogs, unable to control impulses without extreme exertion and difficulty, and overly inhibited dogs, unable to act effectively even under the modest and routine demands of daily life.

Although the pronounced symptoms of behavioral disintegration described in the laboratory are rarely met with in family dogs, many canine behavioral disturbances and compulsions may be attributed to the regular occurrence of events that are unpredictable and uncontrollable. This is especially true in those cases where stimulus events evoke highly emotional and persistent conflicts. From the foregoing observations, one can conclude that remedial training for such dogs should include an effort to identify such sources of conflict and to provide the dogs with consistent and well-organized instructional activity. Behavioral training is beneficial; it makes explicit and constantly reiterates the reliability of significant events, a process that helps dogs to recover their self-confidence and to develop an expectancy that the environment is predictable and controllable.

NEUROSIS AND THE FAMILY DOG

Many everyday situations generate potentially harmful psychological conflicts and distress. For instance, routine disciplinary interaction often lacks sufficient clarity, predictability, and controllability. Further, training signals are not always carefully differentiated from one another. This lack of clarity sets the groundwork for confusion and unproductive training.

Many owners believe that their dog understands words in a way similar to how humans understand language. The urge to attribute humanlike learning and language abilities to dogs is a strong tendency, one that has attracted the noncritical support of many adherents. The belief that dogs can understand language has led some individuals to devise various means to teach them how to communicate symbolically. For example, Elisabeth Mann-Borgese (1965), the daughter of the German novelist Thomas Mann, developed a system that she thought would give dogs the ability to communicate their needs and intentions. The dogs were trained to use a typewriter especially designed for the purpose. Her efforts, as one might guess, were not very successful. Arli, an English setter, the most successful of the dogs she trained, pecked out what appears to be nothing more than meandering and nonsensical "poetry" organized by chance. What is most significant about Mann-Borgese's effort was the use of rather sophisticated instrumental training methods that she developed and used to teach her dog how to type and pick letters on cue. With regard to her other more elevated goals, however, no experimental evidence exists supporting the belief that dogs can learn to use a symbolic language in a way comparable to humans. Although her efforts failed with respect to the use of language in dogs, they did anticipate more recent and successful language learning studies in nonhuman primates.

In the case of dogs, the verbal "messages" they understand are distinctively nonconceptual in nature, being more concrete than abstract or symbolic; further, they are acquired through an associative-contextual learning process rather than a conceptual-symbolic one. Associative learning allows dogs to form a variety of connections between vocal signals and other signals, actions, and emotions having more immediate significance and meaning to them (e.g., visual gestures, physical prompts, and tonal variations of the voice).

Ideally, the differential application of tones of voice associated with reward and tones of voice associated with punishment should mediate a precise "dialectical interface" between the trainer and dog. Confusion is prone to develop when training signals are not consistently differentiated or applied. The ordinary quality of verbal exchange between humans is monotonal. This tendency often slips into the manner in which the owner attempts to communicate with his or her dog, sometimes blurring vital tonal distinctions between reward, command, and reprimand signals. When attractive and aversive signals are vague or lack explicit tonal differentiation, the potential for confusion or internal conflict between the opposing motivations stimulated by the signals involved is increased.

Similarly, when dogs are punished as the result of following an appropriate command (or rewarded for not responding), opposing expectations are likely to collide destructively. As unlikely as this sort of situation may sound, the habit of such punishment is actually very common among inexperienced dog owners. A familiar situation involving such inappropriate punishment can often be seen during recall training. In this case, dogs are sometimes punished only after they finally come or allow themselves to be caught by the exasperated owners. In other situations, dogs may be punished for coming too slowly. Such punitive interaction not only results in unnecessary stress and conflict but also progressively ruins a dog's willingness to come when called. Many persistent recall problems (unwillingness, hesitation, or slowness) can be analyzed along similar lines of improper punishment. Finally, such punishment sets up difficult-to-reverse internal conflicts about approaching when called (approach-avoidance and avoidance-avoidance conflicts), doing great damage to a dog's readiness to coop-

erate and thereby perpetuating a vicious cycle of frustration and ineffectual punishment.

Most dog owners at one time or another engage in the practice of noncontingent punishment (see Chapter 8). This problematic habit is especially prevalent in the mismanagement of separation anxiety and with puppies provided too much liberty before they are ready for it. A typical scenario might involve an owner coming home to find that the dog had been destructive in the owner's absence. Angered by the dog's misbehavior, the owner takes him to the spot or article and punishes him. Over time, such punitive interaction may escalate as the owner becomes progressively convinced—and more determined than ever—that the dog is acting spitefully. Alternately, on those occasions when the owner comes home and finds no sign of the offending behavior, the owner is likely to shower the reformed dog with affection and compensatory reassurance. Interpreting this turn of events to mean that the treatment had caused the dog to improve its attitude, the owner may feel justified in using the spurious cure. Before too long, though, the hiatus of good behavior will inevitably break down again, setting the stage for another series of futile punitive homecomings.

The interpersonal dynamics of noncontingent punishment can be analyzed in terms of experimental neurosis. During the foregoing greeting pattern, the owner is a provider of both attractive stimulation (approach) and aversive stimulation (avoidance) on a contingency not clearly predictable or controllable by the dog. Some days the owner returns home to punish the dog severely, whereas on others (when no evidence of destructiveness is found) the owner offers the dog affection and reassurance. The problem is that neither case is well defined by antecedent signals. The dog does not know which outcome is most likely to occur on any given occasion; neither does the dog know what to do in order to control it—that is, the greeting sequence is both unpredictable and uncontrollable.

The greeting situation is especially problematic because of the intensity of emotional conflict involved. Most dogs are very enthusiastic about seeing their owners after a long absence. The active emotions are intensely affectionate and seek reciprocation—that is, the expectant dog anticipates an equally friendly reply in kind. Instead, his sociable efforts are met with an unexpected and aggressive assault, resulting in a collision of violently opposed and conflicted emotions (structurally similar to Wolpe's and Masserman's procedure reviewed earlier). From the perspective of experimental neurosis, the collision of opposing and mutually incompatible emotional reactions predisposes the dog to develop neurotic conflict. The above homecoming exchange is especially injurious to an emotionally unstable or separation-distressed dog. Carried out over several weeks or months, such interaction may result in the elaboration of neurotic symptomatology, ranging from bizarre approach-avoidance greeting displays to extreme overarousal and hyperactivity. Additionally, affected dogs may exhibit numerous ontologically immature (regressive) displacement activities, compulsive submissive urination, exotic patterns of sham guilt, heightened insecurity, and exaggerated attention-seeking needs. Perhaps most importantly, such treatment contributes to the development of various cognitive generalizations about the unpredictability-uncontrollability of the owner's behavior, thereby planting the seeds for even greater adjustment problems.

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10

Human-Dog Companionship: Cultural and Psychological Significance

The dog, i.e. the domestic wolf, was the first creature with which man got on to intimate terms, or that got on to intimate terms with him, and which in the course of thousands of years became uniquely intensified. No other animal stands in such intimate psychological union with man as the dog, which has almost become his master's thought-reader, reacting to his faintest changes of expression or mood.

H. HEDIGER, *The Psychology and Behavior of Animals in Zoos and Circuses* (1955/1968)

THEORIES OF PET KEEPING

WHY DO people keep pets? Although the answer may seem obvious to anyone who has ever enjoyed the company of a dog, the question has been taken up as a serious scientific problem and answered in a variety of different ways. One of the earliest efforts to investigate the human-dog bond was carried out by W. Fowler Bucke (1903), who surveyed 2804 children, asking them about their attachment and reasons for preferring companionship with dogs over other pet animals. The result is a fascinating inventory of childhood attitudes, feelings, and thoughts about dogs. Bucke's analysis moves from an assessment of the child's motivations to the broader implications of the dog's domestication and close social affiliation with humans, concluding, "The dog has been, and is, a great force in the development and natural education of the child and the race" (1903:509). Another early study was performed by Lehman (1982), who collected data from 5000 child respondents to determine how they spent their time playing. Children of various ages were asked to re-

spond to a series of questions regarding their daily play activities. He found that boys tended to spend more time interacting with dogs than girls did, with both groups showing a steady decline in the amount of time spent playing with pets (both dogs and cats) as they matured.

The study of what Bucke referred to as *cynopsychoses* would remain fallow and suffer neglect over the next several decades. During the past 20 years or so, however, this evident disregard has gradually given way to a renewed interest in the scientific study of human-dog interaction (Fogle, 1981; Katcher and Beck, 1983; Anderson et al., 1984; Serpell, 1986/1996; Bergler, 1988; Rowan, 1988). The contemporary reasons and rationale given for keeping dogs are nearly as varied and numerous as the many breeds comprising the canine family. Further, the general circumstances and motivations that guided early humans to capture and tame protodogs as pets remain subject to a great deal of speculation. These problems have generated a wide variety of hypotheses ranging from the existence of a universal human need for companionship with animals (Messent and Serpell, 1981) to theories based on domestic affiliations that developed (more or less) accidentally after the capture of wild animals. According to this latter group of theories, potential prey escaped the larder by becoming objects of affection (Hediger, 1955/1968; Zeuner, 1963; Scott, 1968; Clutton-Brock, 1977). Understanding why humans kept pet dogs in the distant past and understanding the current motivations that continue to foster the relationship have tremendous welfare implications. Many theories have been promulgated to help explain the human tendency to care for animals as pets, but none are conclusive—perhaps there is no single answer or simple formula. A brief summary follows of three prominent contemporary theories addressing the motives underlying the primal urge to keep animals as pets.

Savishinsky

Joel Savishinsky (1983) analyzed the urge to keep pets by contemporary primitive peoples on various levels of function and purpose. He concluded that while the widespread urge to keep pets might represent a plausible foundation for domestication, only rarely does pet keeping result in lasting intimacy, bonding, and controlled breeding in captivity. According to his observations, there exist several shortcomings inherent to the "pet-keeping urge" when considered as the primary motive for domesticating wild animals. Pets among tribal people are frequently kept only for a short period; they are often abused, poorly fed, and are frequently allowed to die, once the captor's curiosity is satisfied. Savishinsky argues that even though primitive peoples may catch and confine wild animals for amusement or various other short-term purposes, such activities provide little support for the hypothesis that such interests in wild animals precede or result in protodomestication. He warns that the term *pet keeping* should be applied with caution to foraging and hunting societies, especially if one wishes to employ it in the same sense as it is used to describe pet keeping among modern people.

Serpell

An opposing view of pet keeping among tribal peoples has been elaborated by James Serpell (1986/1996, 1987), who concedes that tribal children may expose their animal pets to varying degrees of neglect, abuse, mutilation, or even death resulting from play activities like "target practice," but argues that this attitude does not frequently extend to adults who display genuine affection toward their pets, caring for them in a manner not dissimilar to the way they care for their own children. He identifies two primary motivations underlying the urge to keep domestic animals: companionship and all other purposes like play, food, and status. He found that pet keeping in many tribal cultures is largely independent of economic or other practical concerns. Pets are maintained for the simple pleasures derived from their company and the satisfaction felt in caring for them. Even among those tribal people (e.g., Hawaiians) who kept dogs for food, personal pets were rarely slaughtered and not "without loud protest from the owner."

Yi-Fu Tuan

Yi-Fu Tuan, in *Dominance and Affection: The Making of Pets* (1984), analyzed the urge to keep and domesticate pets from the perspective of an enhanced sense of power. The ultimate significance of pet keeping according to Tuan is intertwined with a more fundamental urge to dominate and control nature. To domesticate is to dominate, control, and modify an animal according to human interests and design. Although the earliest intentions motivating domestication cannot be explicitly demonstrated, Tuan argues that the main motivations from early antiquity through the modern period for keeping and breeding dogs were largely utilitarian. These functions included hunting and guarding roles, but many other uses of dogs can be found, ranging from pest control to shepherding. The modern view of pet keeping based purely on affection and companionship became possible only with the advent of industrialization and the widening schism between humans and nature. As dogs became progressively divorced from a practical function, they could be more often conceptualized and used solely as an object of affection and play. The emergence of modern pet keeping brought with it conflicting urges and sentiments between dominance and benevolence, between cruelty and affection, and between ownership and friendship. The history of pet keeping is one of glaring incongruities and antitheses spawned by these conflicts inherent to pet ownership, training, and breeding.

The stories of Kipling and Aesop quoted below draw upon an idealist's vision of domestication (service, protection, and devotion), tempered by a rather cynical perspective on the whole arrangement. Collectively, these stories provide a unique insight into the psychology of domestication, revealing the perennial pros and cons of domestic existence for dogs and, by analogy, civilized existence for us. Together, they finely sum up our affectionate bond with dogs without evading the darker shadow of cruelty and domination inherent to the domestication process itself:

> Then the Woman picked up a roasted mutton-bone and threw it to Wild Dog, and said, "Wild Thing out of Wild Woods, taste and try." Wild Dog gnawed the bone, and it was more delicious then anything he had ever tasted, and he said, "O my Enemy and Wife of my Enemy, give me another."
>
> The Woman said, "Wild Thing out of the Wild Woods, help my Man to hunt through the day and guard this Cave at night, and I will give you as many roast bones as you need. ..."
>
> Wild Dog crawled into the Cave and laid his head on the Woman's lap, and said, "O my Friend and Wife of my Friend, I will help your Man to hunt the day, and I will guard your Cave." (Kipling, 1982)

Kipling's idealized vision contrasts sharply with the sense of loss and sacrifice attendant to domestication emphasized by Aesop in the fable *The Dog and the Wolf*:

> A Gaunt Wolf was almost dead with hunger when he happened to meet a House-dog who was passing by. "Ah, Cousin," said the Dog. "I knew how it would be; your irregular life will soon be the ruin of you. Why do you not work steadily as I do, and get your food regularly given to you?"
>
> "I would have no objection," said the Wolf, "if I could only get a place."
>
> "I will easily arrange that for you," said the Dog; "come with me to my master and you shall share my work."
>
> So the Wolf and the Dog went towards the town together. On the way there the Wolf noticed that the hair on a certain part of the Dog's neck was very much worn away, so he asked him how that had come about.
>
> "Oh, it is nothing," said the Dog. "That is only the place where the collar is put on at night to keep me chained up; it chafes a bit, but one soon gets used to it."
>
> "Is that all?" said the Wolf. "Then good-bye to you, Master Dog."
>
> Moral: "Better Starve Free Than Be A Fat Slave."

From Aesop's perspective, the loss of freedom is the greatest forfeiture made in exchange for domestic security. His fable is obviously an anthropomorphic metaphor, perhaps revealing more about human compromise and loss of dignity to civilized existence than it does about the dog's loss of autonomy in nature.

According to D. G. White (1991), the dog is a living metaphor that is closely associated with threshold points or boundaries be-

tween wild and domestic life. This role is symbolically embodied in the dog's almost universal association with the domestic threshold or doorway of the home. White notes that the dog is essentially related to human endeavor at the boundary or threshold between "night and day or between indoors and outdoors; or it constitutes a moving periphery, enclosing the herd that it guards from savage predators (often its cousins, wolves) or human rustlers, or providing a moving horizon between nature and culture as it pursues wild game, running ahead of its master, the hunter, who follows in its bark" (White, 1991:14–15). The long domestic association bringing humans and dogs together has been a mutually transforming symbiosis that has had a profound influence on human cultural and social evolution:

> This cohabitation with a great and changing variety of the Canidae, dating from neolithic times, has no doubt played a significant role in the rise of *homo sapiens* to dominance over our planet, in the human transformation of environment into world. ... We cannot overestimate the importance of this relationship to the "humanization" of the human species. Over the past ten to twelve thousand years, as we have completed our biological evolution through development of culture—an evolution parallel to that of the child in its formative years, when prenatal biological development is completed through acculturation—we humans have grown up with dogs at our sides. (1991:13)

These observations are echoed by J. Allman's (1999) emphasis on the mutual support and success enjoyed by the human and canid species in their close association together. He has speculated that early humans migrating from Africa some 140,000 years ago may have achieved a distinct advantage by capturing and domesticating protodogs. As this founding population spread north, the protodog's strengths as an ally may have given these early migratory ancestors of modern humans added powers and a competitive advantage over other human populations who were supplanted by their advances. Considering the recent findings of Wayne and his colleagues (see Chapter 1), who place the dog's domestication back to over 100,000 years ago, this theory of close contact between protodogs and humans has some considerable plausibility. Over the millennia, dogs and humans have complemented one another's existence, perhaps as White points out, with the dog leading the way at the horizon between culture and nature. W. M. Shleidt (1999) agrees with White's suggestion that humans and dogs have had a mutual and pronounced biological and cultural transformative influence on one another. He argues that it was the pastoralist herding pattern of wolves preying on reindeer during the last Ice Age that humans emulated and ultimately succeeded in adopting for their own with dogs at their side. As a result of this close association from such an early date, humans and canids experienced a coevolutionary process resulting in their mutual domestication and adaptation to one another. Both humans and canids appear to have undergone similar paedomorphic and other general morphological changes, including reduced physical stature and brain size. As discussed in Chapter 1, the dog's brain size is approximately 25% to 45% smaller than the wolf's brain. Similarly, the human brain has been shrinking over the past 35,000 years from an average of approximately 1450 grams to a current average weight of 1300 grams (Martin, 1990). This evidence suggests the possibility that similar evolutionary forces were concurrently operating on both humans and dogs, thereby producing similar effects on each species. Obviously, the human-dog relationship has exerted a tremendous biological, cultural, and psychological influence on human development, yet the way it all came about remains shrouded under a primordial veil that only begrudgingly and rarely gives us a glimpse into the mystery of our long relationship with the dog.

FORMING THE ANCIENT BOND

What is the basis for the universal appeal of dogs as companions? While the primeval impulse to keep dogs was certainly utilitarian to some extent, practical incentives alone cannot explain our perennial attachment and fascination. What else may have motivated early humans to capture and domesticate the ances-

tral dogs remains an unanswered and, perhaps, an unanswerable question. The nature of this early bond is likely to remain largely a mystery, since prehistoric human motives are impossible to verify scientifically. Despite the paucity of evidence, several authors have attempted to shed light on the situation by offering their best guesses. Juliet Clutton-Brock (1981), for example, speculated that early humans probably found familiar parallels in the social order of wolves, making interaction between the two species more easy and natural. Both species brought to the relationship analogous behavioral and social tendencies. Both species are cooperative hunters that form extended family relationships, with each possessing similar social structures and behavior patterns conformed to meet the needs of hunter-family groups. These various similarities provided a biological foundation for a close kinship and exchange between humans and dogs:

> The process of taming probably began at least 12,000 years ago but how much has changed in the actual relationship between man and dog in the period it is difficult to assess. It may be that in fact there is very little difference and the relationship is much the same now as it was at the end of the Ice Age. This is because the remarkable kinship and powers of communication that exist between human beings and dogs today have developed as an integral part of the hunting ancestry of ourselves and the wolf. It is a biological link based on social structures and behaviour patterns that are closely similar because they evolved in both species in response to the needs of a hunting team, but which endure today and have become adapted to life in sophisticated, industrial societies. (Clutton-Brock, 1981:34)

As hunters, primitive humans and wolves pursued large prey over open and wooded terrain, exerting tremendous physical and mental energy to accomplish their hunting goals. The result was the development of a high degree of physical strength and intellectual sagacity. Further, hunting was carried out as a group-coordinated and organized activity that required a high degree of social communication and cooperation. Desmond Morris (1967) suggested that the early hunter-gatherer people and the wolf may have been competitors originally, but gradually human hunters recognized the many advantages that the wolf had to offer, including valuable predatory herding and driving instincts, as well as the possession of more sensitive hearing and smelling abilities—all useful in the tracking, locating, and seizing of prey. Although it is doubtful that early humans made much organized use of the wolf's hunting skills (Zeuner, 1963), once domestication was under way it is likely that such use occurred, anticipating the conscious selective breeding of various hunting specialists, for example, gaze and scent hounds, pointers, retrievers, and terriers.

As pointed out by Clutton-Brock, the affinity between people and dogs depends on several shared behavioral and social dimensions conducive to mutual adaptability and interspecies harmony. Perhaps the most important of these factors is the reciprocal ability of humans and dogs to form strong interspecies social attachments with one another. J. P. Scott (1958) studied the social behavior of dogs in detail (as discussed in Chapter 2), isolating several critical or sensitive periods associated with social attachment occurring early in the dog's ontogenetic development. During the ensuing socialization process, strong bonds are formed that persist throughout a dog's life. If a puppy is removed from littermates prior to the onset of the socialization period, the puppy will tend to form rather exclusive attachments to humans, becoming progressively fearful or aggressive toward conspecifics as an adult. The socialization effect produces a profound impact on a dog's social identity (species recognition) and social preferences.

One widely held theory of domestication suggests that wolf pups may have been taken from their mothers and reared by humans in an effort to tame them. Studies of captive wolves have shown pronounced taming effects resulting from such early socialization, especially if the pups are taken from their mothers before the onset of the socialization period and raised in close association with people. Young and Goldman (1944/1964) collected numerous reports concerning the taming and practical use of wolves by both Native Americans and settlers. The authors

noted early on that the best benefits of socialization occur when socialization is initiated shortly after a pup's eyes open. John Fentress (1967) successfully socialized a hand-reared wolf named Lupey from 4 weeks of age—an age considered questionable by many authorities for the successful socialization and taming of a wolf. Lupey was very affectionate and playful toward both humans and dogs but unpredictable or predatory toward small animals. He killed his first chicken by the time he was 13 weeks of age. Although involved in several incidents where intense threat and defensive displays were exhibited, Fentress did not report any serious attacks occurring during his 3 years of observations, underscoring the important role of familiarity, affection, and trust for the inhibition of aggressive behavior.

J. H. Woolpy and B. E. Ginsburg (1967), who analyzed in detail the dynamics of the socialization process between humans and wolves at various ages and periods of social development, found that the incipient development of fear from week 6 or 7 onward competed with successful socialization efforts. However, once socialized, wolves exhibit "all the attitudes and mannerisms of a very friendly dog." The researchers discovered that even adult wolves could be rehabilitated if patiently handled through four gradual stages of progressive socialization: (1) escape, (2) avoidance, (3) approach-aggression, and (4) friendly or socialized interaction. During initial contact, unsocialized wolves become highly emotional, exhibiting various escape efforts, signs of autonomic arousal [panting, salivation, pupillary changes (dilation), urination, and defecation], and various postural signs of fear (crouched posture, tail tucked between the rear legs, and trembling). After approximately a month of passive contact, the wolf may begin to relax somewhat but still not accept the approach of the handler. The next stage begins with the wolf making more active approaches sometimes involving biting on clothing, rubbing up against the handler, and the acceptance of petting. This stage is frequently associated with intense threat displays and a strong risk of attack, requiring special precautions and procedures to overcome. After several months of regular contact, the wolf may begin to solicit and reciprocate friendly exchanges involving licking, mouthing, and tail wagging. The benefits of socialization depend on the animal gradually learning to cope with a persistent fear of the unfamiliar.

AFFECTION AND FRIENDSHIP

Although differences of opinion exist regarding the role of companionship and intimate bonding during the early stages of domestication, clearly the contemporary urge to keep dogs as pets involves some constellation of emotional interests like intimacy, play, companionship, and security—perhaps in some cases even offering an ersatz relationship in lieu of satisfying human company. Unlike human relationships with other domestic animals, the social and psychological bond between people and dogs is profound and complex. Although very different biological entities, humans and dogs share a closeness and affinity that have linked the two species in close friendship over many thousands of years and have carried each other to every corner of the globe. Konrad Lorenz, obviously moved by his heartfelt compassion for dogs, wrote of the affectionate bond between humans and dogs in the most touching terms:

> To love one's brother as one does oneself is one of the most beautiful commands of Christianity, though there are few men and women able to live up to it. A faithful dog, however, loves its master much more than it loves itself and certainly more than its master ever can be able to love it back. There certainly is no creature in the world in which "bond behavior," in other words personal friendship, has become an equally powerful motivation as it has in dogs. (1975:x)

Following along a similar vein of analysis, Boris Levinson (1961, 1969) emphasized that the most important function of dogs in human families is a psychological one, providing a resource for nonjudgmental acceptance and affectionate exchange. In psychological terms, dogs play the role of a safe *transitional object* hovering between fantasy and reality, providing a mediating conduit for the expres-

sion of wishes, fantasies, and aggressive impulses (unfortunately often making dogs a target for mental and physical abuse). According to Marcel Heiman, "The dog may be considered a descendant from a totem animal used by man in his development and useful to him in the process of civilization. It is noteworthy that *the dog's psychic apparatus, in its fundamental features, seems to conform to that of man.* ... The domesticated animal, in particular the dog, is for civilized man what the totem animal was for the primitive. The dog represents a protector, a talisman against the fear of death. ... By displacement, projection, and identification, a dog may serve as a factor in the maintenance of psychological equilibrium" (1956:584, italics added). In the view of many psychoanalytically oriented psychologists, our attitudes and feelings about animals are an expression of unconscious strivings and repressed components of the self.

Similarly, Samuel Corson and his associates (1977) suggested that the dog's appeal rests mainly on its ability to give love and tactile intimacy while remaining a perpetually dependent and innocent object of our care and affection. Perhaps, though, there is an even more important factor to consider: the dog's native ability to inspire in us a sense of play and frivolity. Dogs yield to the willing and receptive participant permission to become childlike and revel in the joyful release of play and momentary self-abandonment, revealing the "wonderful secrets having to do with the great dog art of living abundantly and happily in the present tense regardless of circumstances" (Boone, 1954:74).

The Effect of Person

Clearly, an intuitive or empathetic faculty plays a role in deciphering and interpreting such signalization, whether between dogs and humans or between dogs and other conspecifics. For example, tail wagging is a commonly relied upon social signal for determining an animal's degree of positive social intention. In fact, the signalization expressed by tail wagging is virtually universal among domestic mammals. Kiley-Worthington (1976) studied various situations in which tail wagging occurs in domestic animals (pigs, cattle, goats, horses, dogs, and cats) and found a strong concurrence of tail wagging in these different mammalian species occurring under similar stimulus situations. The dog's social response to familiar versus unfamiliar persons is clearly differentiated by tail position and movement. Rappolt and colleagues (1979) found that dogs approached their owners with a lowered and actively wagging tail. Strangers, on the other hand, were approached more ambivalently with the tail wagging in a more subdued manner and held at a higher position, especially as the stranger moved into close contact.

Other observers have noted that some people appear to be inherently more attractive and calming to dogs, whereas others are more repulsive and agitating. Wolves apparently prefer contact with female humans over males, the latter of whom they are more suspicious and wary (Fox, 1980). Lore and Eisenberg (1986) found that, during social approach tests, male dogs advanced toward female subjects more readily than they did toward male subjects. However, female dogs willingly approached and made friendly contact regardless of the subject's gender. The causes of this differential social response are not fully understood, but the effect of person can have a calming or disruptive effect on a dog, depending on the individual making contact. Social "chemistry" may play an important role in the etiology of behavioral maladjustment and the development of some behavior problems. Many trainers and behaviorists have anecdotally noted that occasionally a persistent behavior problem spontaneously improves simply by placing the dog in a new home.

W. Horsley Gantt (1972) (see Chapter 9) discovered that dogs experience significant cardiovascular changes as the result of petting. These so-called *effects of person* are reciprocal between humans and dogs. Vormbrock and Grossberg (1988) confirmed earlier findings by Katcher (1981) that petting a dog causes a lowering of blood pressure in human subjects. In the Vormbrock and Grossberg study, blood pressure and heart rate were measured under three different conditions: while subjects were petting a dog, while pet-

ting and talking to a dog, and while talking to the experimenter. They found that the subjects experienced a significant lowering of blood pressure and heart rate while petting the dog, opposed to an increase while talking to the experimenter. Interestingly, lower heart rates were observed in subjects while either touching or talking to the dog, but, paradoxically, became higher when both touching *and* talking to the dog. Friedmann and colleagues (1980) found that coronary patients that have companionship with a dog (or other pet) enjoyed a significant prognostic advantage over patients not possessing a dog. Corson and coworkers (1977) studied the benefits of pet-facilitated psychotherapy, claiming improvement in patients who failed to respond to traditional therapy alone. Corson and Corson also studied the effects of pet dogs on the well-being of geriatric patients and isolated several therapeutic benefits presumed to stem from close interaction with dogs:

> Pet animals, and especially dogs, offered nursing home residents (including mentally retarded individuals) a form of nonthreatening, nonjudgmental, reassuring nonverbal communication and tactile comfort and thus helped to break the vicious cycle of loneliness, helplessness, and social withdrawal. Pet animals acted as effective socializing catalysts with other patients, residents, and staff and thus helped to improve the overall morale of the institution and create a community out of detached individuals. (1981:170)

Although there appears to be a clear psychological and physiological benefit derived from companionship with animals, the scientific studies thus far carried out are largely of a nongeneralizable statistical variety, many of which provide only limited validation for the hypothesized beneficial therapeutic effects of animal companionship (Wilson and Netting, 1983; Barba, 1995). Barba (1995) reviewed the human-animal interaction literature and found serious procedural shortcomings, with over 25% of the authors inappropriately generalizing beyond the sample parameters of their studies. Further, controlled experimental studies are unfortunately rare in the human-animal interaction literature. Of those controlled studies that do exist, few show a strong benefit derived from animal companionship and, unfortunately, those that do show benefit often suffer procedural shortcomings that undermine their validity. Beck and Katcher (1984), for example, were able to find only six controlled studies—none of which showed evidence of the "dramatic" results commonly observed in case reports.

There can be little doubt that companionship with dogs can provide significant benefit for people in the home, institution, and other walks of life, but the official acceptance of a therapeutic role for dogs will hinge on the development of replicable statistical studies and controlled experimental investigations. Claims not justified by data-based findings do nothing to support the future development and more widespread use of dogs in clinical and institutional settings. What is needed is unbiased and procedurally sound studies that place animal-assisted therapy on a more firm foundation of science.

When the Bond Fails

Dogs enjoy a close association with people all around the world, playing many diverse roles ranging from family pet to guide dog for the blind. Despite the ubiquitous and affectionate affinity between humans and dogs, the relationship is filled with paradox and irony. A short survey of a few pertinent statistics reveals that human love for dogs is overshadowed by a disturbing display of indifference and outright cruelty.

The United States is the world leader in dog ownership. The Pet Food Institute (PFI) (1999) estimates that approximately 57.6 million dogs live in America, with 37.8% of all households keeping at least one dog. A survey conducted by the American Veterinary Medical Association (AVMA) puts the U.S. dog population at 52.9 million (AVMA, 1997)—up by approximately 400,000 since their last survey in 1991. American dog owners lavish affection and expensive care on their pets, spending approximately $5.6 billion (PFI, 1999) on food alone each year to keep their canine companions well nourished and another $7 billion to keep them healthy (AVMA,1997). According to the updated *US Pet Ownership and Demographic Sourcebook*

(AVMA, 1997), these expenses are on the rise, with the average cost of veterinary care climbing from $132 per dog-owning household in 1991 to $187 per household in 1996. Interestingly, between 1991 and 1996, the cost of veterinary care for the dog has risen by $2.08 billion, even though the mean number of veterinary visits for dogs has actually declined by 3.5% over the same period.

Indifference and Irresponsibility

Although dog owners can be generous and loving, they can also be equally selfish and cruel, frequently treating their pets with heartless disregard and insensitivity—if not outright contempt. Family dogs often fall victim to a "throw away" mentality adhering to their property status. A telling study reported by Line (1998) collected data on domestic animals relinquished to the Animal Humane Society in Minneapolis, including 20,903 dogs and puppies. Among some of the most common reasons given for surrendering dogs to the shelter were "moving," "no time," "too energetic/needs training," "responsibility is too much," and "needs more attention." In total, these reasons represent 42.6% of the causes given by respondents for relinquishing their pet dogs to the shelter. Similar statistics were reported by Salman and colleagues (1998), based on data from 12 U.S. animal shelters showing that 54.5% of respondents gave reasons related to housing or lifestyle issues. The American Humane Association (Nassar and Fluke, 1988) estimates that between 10.3 and 17.2 million dogs enter the shelter system each year. Of these, only 19% are placed in new homes, with the remainder being either redeemed by their owners (15%) or euthanized (66%). Anderson (1992) found during a survey of North Carolina shelters and humane organizations that approximately 76% of all dogs entering a shelter are euthanized, with only 18% being placed in new homes. The fate of the fortunate ones that find a home is not free of risk. Arkow and Dow (1984) found that dogs obtained from animal shelters were relinquished at a much higher rate (42%) than dogs acquired from other sources, suggesting the possibility that some behavior problems may be recycled through the shelter system. A rather disturbing finding reported by Arkow and Dow comes from Colorado Springs, CO. In that community, they estimated that 40% of the resident dog and cat population annually changes homes. Further, it was reported that the community shelter euthanizes 10% of the dog and cat population each year. According to the Humane Society of the United States, approximately 20 million unwanted or abandoned pets (dogs and cats) die annually as the result of euthanasia, exposure, starvation, or trauma. The picture is disconcerting, since it appears to indicate that dog ownership is perceived in terms of convenience rather than commitment and responsibility. Salman and coworkers (1998) found that only 4% of the surrendered dogs had been sent to obedience classes and a mere 1.2% had received professional training. The absence of obedience training appears to represent a strong risk factor for relinquishment. Another disturbing finding reported by Salman and associates is that a full third of the relinquished dogs had never been to a veterinarian. These statistics testify to a pronounced element of insensitivity and neglect, perhaps even institutionalized cruelty, toward companion animals—a sad and bitter culmination to our long history and friendship together.

Role of Behavior Problems

Another common and serious obstacle in the way of satisfying and affectionate companionship with man's best friend is behavior-adjustment problems. Estimates vary widely with respect to the incidence of behavior problems in dogs. A random sampling of 711 dog owners carried out at the University of Pennsylvania revealed that approximately 42% of the respondents answered "Yes" when asked, "Does your dog engage in any behavior which is a problem for you?" (Voith et al., 1992:265). The most common complaints were aggression, elimination, vocalization, destructive behavior, ingestive, running away, disobedience, and fearful behaviors. Other studies have reported much higher percentages of dog owners experiencing behavior problems with their dogs. For example, Adams and Clark (1989) found that 86% of

105 dog owners randomly interviewed in public places (Perth, Australia) reported at least one behavioral complaint. Similar numbers were reported by Campbell (1986), who found that 87% of 1422 dog owners indicated that their dog exhibited at least one behavior problem. The most common problems were jumping up on people, barking, begging, jumping on furniture, digging, destructive chewing, and fears (noises). In another survey (reported in Sigler, 1991) of veterinary clients, 90% of the respondents said they would like to improve their dog's behavior. From these studies, it is probably safe to conclude that the vast majority of dogs exhibit some need for behavioral training at some point in their lives as the result of a behavior problem. Hart and Hart noted in this regard that "behavioral problems in dogs and cats are so common that it is perhaps unusual to have a pet with no problems" (1985:vii).

Behavior problems are not only a nuisance, they are also a serious risk to the welfare of dogs, representing a leading cause for relinquishing the family dog to the uncertain fate of the shelter or to euthanasia (King, 1991). Some authorities claim that approximately 50% to 70% of all dogs euthanized in the American shelter system are surrendered as the direct result of a behavior problem (Sigler, 1991). Others have cranked the estimate of the number of dogs euthanized in the shelter system up to 11 million each year in shelters, with more than half of them being euthanized as a direct result of a behavior problem (Burghardt, 1991; Landsberg, 1991). Overall (1997) estimated that at least 7 to 8 million animals die in shelters each year because of a behavior problem, with an equal or greater number of animals being euthanized in private veterinary practice for similar reasons. Also, Reich and Overall (1998) claim that "abnormal or problem behaviors kill more pets annually in the U.S. than do infectious, metabolic, and neoplastic disease combined." These estimates are especially distressing when one considers that only half of 1% of the cat, dog, and horse owners utilized veterinary behavioral counseling in 1996 (AVMA, 1997), suggesting that behavioral intervention may be an underutilized treatment modality, with many veterinarians simply opting to euthanize the problem pet.

Recently, however, these numbers and estimates have been challenged by more carefully collected and analyzed statistical data, suggesting that considerable "overkill" may be present in the foregoing assessments (Line, 1998; Salman et al., 1998). Of the reasons given by owners for surrendering their pet dogs, behavior problems amounted to less than 30% (Line, 28%; and Salman, 26%), with a small percentage of these dogs being relinquished because of aggression toward people (Line, 3%; and Salman, 9.8%). These findings are consistent with those of Arkow and Dow (1984), who analyzed the results of a questionnaire sent out to several animal shelters across the country. Over 900 respondents were asked a series of questions regarding their reasons for giving up their dogs. Arkow and Dow found that 26% of the respondents had decided to surrender their dogs as the result of a behavior problem. Taken together, these data would suggest that far fewer than 50% to 70% of those dogs entering the shelter system are euthanized as the result of a behavior problem, as previously reported by several authors. In a study sponsored by the National Council on Pet Population Study and Policy (NCPPSP), data from four shelters located in different regions of the United States were collected, showing that, of 3415 animals surrendered to the participating shelters, 12% of their owners noted a behavior problem as a reason for their relinquishment (Anonymous, 1997).

In sum, these statistical trends suggest that far fewer dogs and cats are being euthanized because of behavior problems than had been previously estimated. Rowan (1992) estimated conservatively that the actual numbers involved are probably far smaller, with between 2 and 6 million animals (dogs and cats) being euthanized in the United States every year. After carefully analyzing the available statistics, he concluded that the statistical methods used to assess the euthanasia data are inadequate, resulting in what he referred to as a "statistical black hole." An effort is currently under way, led by the NCPPSP, to remedy this situation by collecting and analyzing pet population and demo-

graphic information in a more controlled and systematic manner. Perhaps, in the near future, more reliable information will become available to estimate the extent of the problem realistically. The bottom line is that a vast number of dogs die every year as the result of various behavior problems, but no one really knows for sure exactly how many dogs are involved.

Undoubtedly, a significant source of conflict and tension is caused by behavior problems, but despite these negative by-products of dog ownership many families and individuals opt to keep their problem dogs rather than surrender or euthanize them. Voith (1981a) found that a leading factor informing the final decision whether to keep or to get rid of a dog was the degree of affectionate attachment between the owner and dog. Of 100 cases (dogs and cats) involving serious behavior problems, 55% of the owners cited affectionate attachment as the primary reason for keeping their dog. Another 16% noted a humanitarian obligation, whereas many others claimed that they never viewed getting rid of the dog or cat as a possible consideration (Voith, 1981b). In another study, Voith (1984) found that 99% of over 700 respondents regarded their dog as a family member.

These findings emphasize the importance of early and effective intervention. It is reasonable to assume that the longer a behavior problem is permitted to persist, the more likely it is that the owner's affection for the dog will be negatively impacted. A family can invest just so much patience and tolerance before giving up on a beloved dog that has developed a serious behavior problem. Waiting until the dog bites before recommending training or behavioral counseling may be too late. It is imperative, therefore, that breeders, groomers, veterinarians, and other professionals involved with dogs be watchful for early signs and refer clients for training or behavioral counseling before it is too late.

Psychoanalysis and the Human-Dog Bond: Conflicts and Contradictions

As already discussed, Tuan emphasized the conflicting urges of dominance and affection, cruelty and kindness, and other similar opposing motivations underlying the human urge to keep dogs as pets:

> In its long association with humans the dog has become diversified to an extraordinary degree, perhaps more so than any other animal species. Moreover, in the Western world at least, the dog is the pet par excellence. It exhibits uniquely a set of relationships we wish to explore: dominance and affection, love and abuse, cruelty and kindness. The dog calls forth, on the one hand, the best that a human person is capable of—self-sacrificing devotion to a weaker and dependent being, and, on the other hand, the temptation to exercise power in a willful and arbitrary, even perverse, manner. Both traits can exist in the same person. (1984:102)

Understanding the nature of these motivational conflicts and how they impact on the human-dog bond is of considerable importance. Much of this literature is admittedly speculative and often difficult to defend on scientific grounds; however, notwithstanding these various shortcomings, the information provides a valuable philosophical texture and backdrop for viewing some pathological and destructive facets of human-dog interaction.

Domestic dogs often grow up within a circle of privileged status existing somewhere between a toy and a child. Under such conditions, normal boundaries are often suspended on both behavioral as well as psychological levels, allowing dogs a great deal of behavioral latitude. Psychologically, the suspension of boundaries between the owner and dog permits an introjective process, whereby the dog is internalized as an ideal transitional object of affection (Levinson, 1961). This *enmeshment* results in an interspecies projection of meaning and emotional content. Introjective possession of the dog and the resultant projections tend to promote a relationship that is decidedly one-sided, selfish, immature, unrealistic, and dysfunctional, all ostensibly aimed at providing the dysfunctional owner with some degree of psychological equilibrium.

No relationship is ideal and, as problems emerge, some owners choose denial rather than face the facts. Others view the dog's behavior in less than ideal terms, attributing to it characteristics such as spitefulness, stub-

bornness, stupidity, and other convenient anthropomorphic interpretations. Under the influence of such confusion and irrationality, owners are prone to experience a variety of interactive problems with dogs (O'Farrell, 1997). As time passes, these dysfunctional dynamics may both polarize and profoundly distort an owner's perception of a dog. In addition, some owners may unconsciously approve and unwittingly perpetuate the very behavior problems they are seeking to eradicate. Heiman addressed this general issue, describing a patient he treated whose symptoms mirrored many of the problems she observed in her dog:

> In another session, two factors became clear: the patient's ambivalence toward the dog's behavior and the degree to which she and the dog formed a psychological unit. The patient recognized that she unconsciously approved of the very acts of the dog that she tried to curb. Thus she unconsciously permitted the dog to act toward her as if the dog were himself a child, and she were her own mother at that time. Here we see clearly the strength of the aggression acted out through identification with the dog. (1956:575)

Constance Perin (1981) has written a probing psychological analysis of the inherent contradictions and emotional conflicts observed in the American attitude toward the family dog. She divides dog owners into one of two general categories: the *responsible* and the *negligent.* The intention of her study was to isolate contributory factors underlying the development of these two styles of dog ownership. She argues that the dog is the conflicted object of an idealized love compounded with anger and infantile memories of a forever lost "once in a lifetime" bond between the infant and the mother. The dog is a symbol of superabundant intimacy informed with a paradoxical sense of profound loss, separation, and isolation—a schism that must be reached across and closed through social bonding with a biologically (and symbolically) distant companion. Instead of representing the dog as a surrogate child, Perin argues that the dog is more proximately characterized as an ideal parent from whom we receive "complete and total love," "undying fidelity," and "nonjudgmental acceptance":

> We are, speaking symbolically, the children of our dogs. Our species difference further signifies that ultimate yielding of our parental ties and, in growing up, our coming to terms with our separateness. The Anglo-American bond with dogs is, I will try to show, a symbol of the most fundamental properties of human existence as our culture has come to understand it. (1981:79)

Later in her essay, she writes,

> Our relationship to dogs symbolizes our own fidelity to human continuity, biological and emotional. The meanings that this symbol makes available renew people's trust in one another. They help to make society possible. (1981:87)

At the core of this relationship is a universal existential crisis comprised of a psychic constellation of insecurity, anger, and longing resulting from the loss of the primal union with the mother. The ambiguous attitudes of idealization, affection, and cruelty displayed by negligent dog owners reflect a psychic imbalance and distortion maintained under the influence of repressed feelings of disappointment and anger emanating from this original loss and separation from the protective and loving parent. Heiman also noted similar dynamics in his patient and her various attitudes toward her mother, child, and dog:

> Just as the patient was about to move to the country for the summer, she discovered she was pregnant. Because of her anxiety, we agreed that she come for treatment once a week. Separation again mobilized great amounts of anxiety in her. Separation from the representative of mother meant death for the patient; thus the birth of the baby, separation from mother, being castrated, were equated with death. Whenever the patient identified herself with the dog and displaced her own unconscious wishes onto him, she spoke alternately of the dog and her baby. Her child was also identified with the mother. Her ambivalence about separation and attachment was expressed toward mother, baby, and dog. (1956:575)

According to Perin, these ambivalent and conflicted feelings are unconsciously pro-

jected onto the dog as a symbolic parental object, resulting in a perpetual cycle of love and cruelty (often unconsciously and obscured with denial). A kind of asexual Oedipal complex appears to be played out, with the dog serving as both the beneficiary of affection and the innocent childlike victim, cyclically destroyed, resurrected, and renewed.

The result of these ambivalent feelings of the owner is internal conflict and the inability to respond appropriately to the dog's behavior. Such owners tend toward extremes of unduly loving their dogs or wanting to kill them; as a result, they are often unable to do anything at all. One is inclined to suspect that herein lies the cause of the striking lack of assertiveness among some owners of dominant-aggressive dogs. It should be noted that these same people are, more often than not, very successful and aggressive competitors in their own professional fields. In some of these cases, there might exist a history of abuse and an established frame of reference correlating love and affiliation with violence, thereby shedding light on the willingness of some owners to tolerate their dog's frequent threats and actual biting. Heiman remarks poignantly on this matter:

> When the patient had adequately worked through her preoedipal relationship with her mother, the dog apparently had served its function. The dog was given to her mother, as an unmarried girl sometimes relinquishes her illegitimate baby. ... The dog helped maintain the patient's emotional equilibrium. A mother's use of a young child to act out a sadomasochistic conflict is destructive to the child, and mobilizes intense guilt in the mother; displaced to an animal, the consequences are comparatively harmless. (1956:578)

One must wonder how harmless such dynamics of displacement are for dogs, both in terms of their emotional equilibrium and physical safety. The use of dogs as outlets for negative emotions seems to have had a fairly widespread acceptance during this general period of time. In a rather bizarre and unsettling report exploring the psychosocial benefits of dog companionship for children, Bossard seriously recommended that dogs be used as ready objects for such hostile personal needs as releasing pent-up ego frustration and gratification:

> If things have gone wrong, and you feel like kicking some one, there is Waldo, waiting for you. If you have been ordered about by the boss all day, you can go home and order the dog about. If mother has made you do what you did not want to, you can now work on the dog. Long observation of children's behavior with domestic animals convinces me that this is a very important function. Often the child has been the victim of commands, "directives," shouts, orders, all day long. How soul-satisfying now to take the dog for a walk and order him about! This is a most therapeutic procedure. (1944:411)

Besides using dogs as cathartic objects for aggressive feelings, Bossard also promoted the use of family dogs for sex education, arguing that "the external physical differences of sex can be seen, identified, and discussed, without hesitation or inhibition on the part of either parent or child" (1944:411). Unfortunately, this sort of pedagogy may, in addition, facilitate abusive handling and treatment when children are left alone to investigate on their own. Recommendations like those of Bossard neglect to appreciate that dogs are feeling victims, albeit silent and forbearing, until at last they are pushed to the limits of tolerance, with the all-too-familiar devastation for both the child and dog.

Rynearson (1978) presented a series of relevant case histories involving human-animal companionship and the dynamics of pathological attachment. In one of these cases, an opposite situation to that just described, was reported involving a daughter, mother, and shared dog. In this case, the patient, who had just suffered a quarrel with her "borderline" psychotic mother, killed herself and her dog. The quarrel stemmed from the mother's demand for full custody of the dog from her daughter "because she wasn't loving him enough." The daughter became enraged and forcefully threw her mother out of the house and then proceeded to kill the dog and herself. Rynearson argues that, in most cases, interaction and attachment between humans and companion animals is harmonious and

complementary; in cases involving pathological attachment and "displacement," however, two primary psychical functions may be served:

> (1) *Sustaining projective identification.* In "anxiously attaching" oneself to and "compulsively caring" for the pet, one can simultaneously and vicariously gratify a vulnerable part of the self without risking interpersonal involvement. The pet is symbolically imbued with the warm, trusting, and unconditional caring that magically nurtures the regressed, insatiable craving of the human for closeness. This degree of involvement occurs in patients with limited ego strengths and recapitulates the regressed mother-infant attachment dynamic.
>
> (2) *Symbolic intermediary.* The pet may become the focus of complicated displacement between conflicted humans [triangulation]. In a family where various members mutually distrust attachment the pet may serve as an attachment figure through which they can indirectly interact attachment. The pet becomes a trusting participant in a drama of distrust, sometimes ending in sacrifice. (1978:553–554)

It is fair to assume that, under certain circumstances, contact with dogs may be employed by some individuals as a psychological crutch used to help manage the individuals' personal emotional conflicts and anxiety. The resultant inconsistent interaction, including the application of punishment or reward based largely on the owner's shifting moods and psychological needs, has been implicated as a possible factor in the development of displacement activities in susceptible dogs (O'Farrell, 1997).

Communicating, Relating, and Attachment

The ease with which humans and dogs interact and socially bond depends on a shared substrate of sociobiological similarities and the ability to exchange socially significant information. The organization of such exchange is mediated by a variety of intention signals expressed through communicative facial gestures and bodily postures understood by both species. Galton emphasized the vital role played by interspecific communication and empathy in the process of domestication:

> The animal which above all others is a companion is the dog, and we observe how readily their proceedings are intelligible to each other. Every whine or bark of the dog, each of his fawning, savage or timorous movements is the exact counter part of what would have been the man's behavior, had he felt similar emotions. (1883:262)

Humans and dogs do share a surprisingly similar repertoire of affectionate and agonistic behavior patterns associated with appeasement and dominance contests (Eibl-Eibesfeldt, 1971). Although not without imperfections, humans and dogs communicate their intentions fairly well to one another and are able to mutually adjust accordingly to the demands expressed. Many et-epimeletic (care seeking) and epimeletic (caregiving) behavior patterns exhibited by people and dogs share homologous features. Both humans and dogs are dependent as young on a mother for nursing, warmth, and protection; they exhibit similar distress vocalizations when cold, hungry, or separated from siblings or maternal contact; and they exhibit a long developmental period involving playfulness. People and dogs share a strong tendency to coordinate their activities together. Allelomimetic (group-coordinated) behavior is a shared feature of both human and canine social organization. Schenkel (1967) has provided a descriptive analysis of the wolf's social displays and signals with respect to social rank and agonistic intention (Fig. 10.1). All of these considerations certainly play a role in the formation of the human-dog bond and the ability of humans and dogs to mutually communicate their intentions and needs.

What Is Communication?

A great deal of the discussion thus far and much of what follows concerning the bond between humans and dogs hinges on effective interspecies communication. What precisely does it mean to communicate with a dog? On a most basic level, communication can be defined as the reciprocal exchange of information between two or more individuals. Most animals possess a complex and flexible repertoire of expressive behaviors used to convey significant biosocial information to

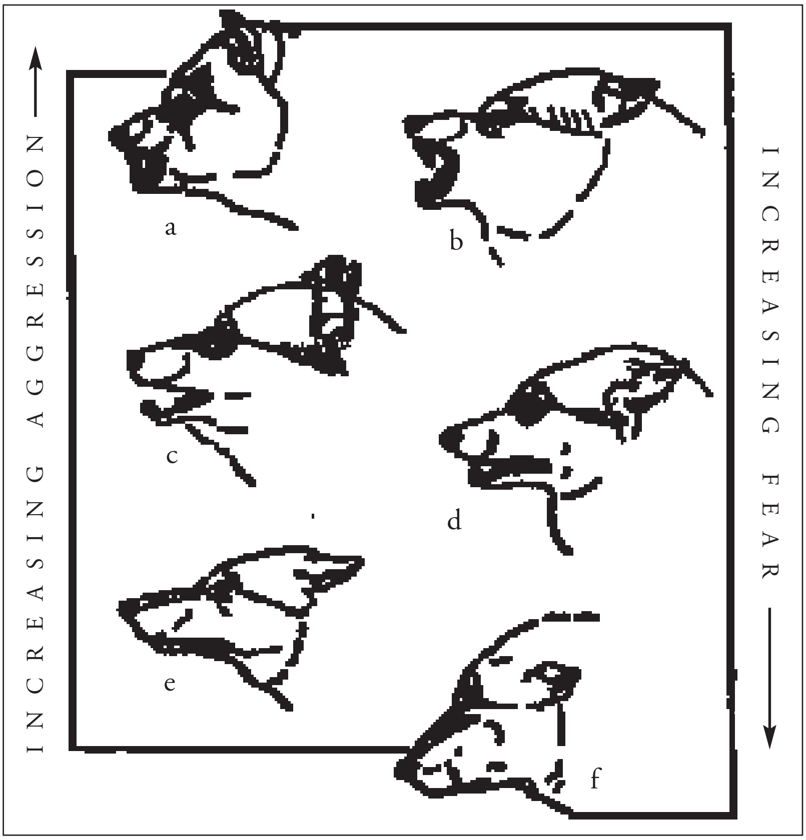

FIG. 10.1. Various emotional expressions of the wolf: (**a**) strong threat, (**b**) threat with uncertainty, (**c**) weak threat with increasing uncertainty, (**d**) weak threat with fear, (**e**) anxious submission, and (**f**) suspicion/uncertainty. After Schenkel (1967).

one another. A communicative exchange consists of at least three components: a sender, a reciprocating receiver, and a signal. The sender emits a signal to effect some change in the attitude, mood, or behavior of the receiver. The receiver confirms receipt of the information by sending an appropriate reply, indicating to the sender whether his or her message served its intended function. These species-typical displays are composed of various facial changes and bodily movements, odors, vocalizations, and tactile contacts that are organized to convey specific information between the sender and receiver. Besides the obvious function of communicating a message, expressive social behavior also exercises an important modulatory effect over emotion and mood. The purposes served by communication extend to all vital interests, but those of most particular concern here are those subserving social behavior.

Communication and the Regulation of Social Behavior

Most social behavior is mediated by communicative exchange with some assumed purpose, although it is not always obvious or apparent what that purpose might be. In highly social animals like dogs, communicative exchange serves to regulate social interaction between group members while facilitating cooperative behavior vital to the group's survival interests. The efficient coordination of cooperative behavior depends on the constant and reciprocal exchange of information between

members. In wolves, a complex repertoire of threat and appeasement signals has evolved to regulate dominant-subordinate relations within the pack's hierarchically stratified social structure (Schenkel, 1967). Many of these agonistic displays are evident in the dog's behavior, reflected both in the way dogs interact with other dogs (intraspecific) and with human companions (interspecific). Besides socially stratifying and distancing signals, dogs possess a variety of affiliative signals employed to enhance social unity and affectionate exchange between group members. The greeting ritual and play bow are typical examples of socially affiliative and affectionate social expressions.

Agonistic and affiliative exchange serves many regulatory functions over the social behavior of dogs. These social communication systems reflect a highly influential social motivational substrate composed of a dyad of opposing and complementary drives (dominance and affection) that together simultaneously stratify and unify group members.

In an early effort to understand and appreciate the dog's social communication system, Darwin (1872/1965) described and cataloged many of the typical social displays exhibited by dogs. Communication systems evolve as the result of persistent social pressures placed on animals from generation to generation to conform to the greater social group or perish. Many of these expressions are innately programmed and reciprocated without much voluntary control or deliberation, but many are modified and organized by the influence of experience. Among the most conspicuous (i.e., distinctive and clear) social expressions are those associated with threat and appeasement (Fig. 10.2). Numerous exaggerated and subtle facial and postural changes are configured to express exact moment-to-moment motivational changes and intentions. The effects of these signals on the receiver depend on the *law of stimulus summation*, with each heterogeneous element expressed during agonistic displays being added together to determine or quantify the degree

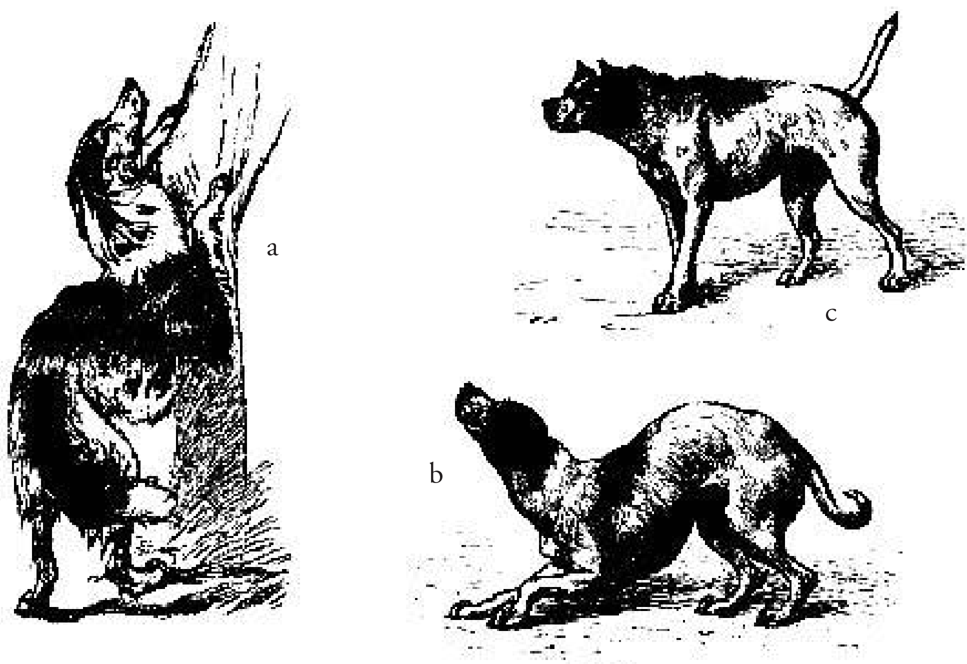

FIG. 10.2. Darwin observed and described many of the ways that dogs communicate social intention, ranging from active and passive submission (a and b) to offensive threat (c). From Darwin (1872/1965).

of imminent threat (Leyhausen, 1973). During a strong threat, dogs stand tall on their toes with hackles raised, ears erect, and tail held stiffly up. The body is tense, with the eyes singularly focused on the target, holding it transfixed with a steady and unwavering gaze. Under conditions of increasing threat, dogs retract the upper lip back and up to unsheathe the front incisors and large canines. This snarling action is often followed by a menacing low growl in immediate preparation for attack. These messages are received by subordinates and reciprocated with a parallel pattern of opposing submission displays or escalating reciprocal threat displays. If subordinates submit, the submission displays correspond in kind and quantity to the threat presented, following what Darwin called the called the *principle of antithesis*. The posture of subordinates is characterized by a diminution of size and strength, often with a lowering of the head and body toward the ground. The body tends to lean back and away from an aggressor, with ears pressed back and tail carried tightly between the legs. Some submissive dogs "grin," lick nervously, or vocalize in a high-pitched whine or yelp when they are challenged. Under conditions of increasing threat, a subordinate may cower to the ground or roll over into a lateral recumbency and expose the belly. Some dogs, especially puppies, may urinate as an ultimate act of deference. In cases where intense fear is also involved, dogs may release the anal glands. Although subordinates will not lose sight of a dominate challenger, they will carefully avoid making direct eye contact during the challenge. The forward and direct position of dominant dogs often intersects subordinates from the side, forming an agonistic-T shape in which the head of the more dominant animal may be jutted over the shoulder of the subordinate.

A dog's motivational status and intention are communicated through its expressive behavior. Anticipating what a dog is going to do next depends on properly identifying and interpreting these signals. Expressive behavior is typically compounded of conflicted intentional elements mirroring competing emotional states. Lorenz (1966) analyzed the facial threat and appeasement displays of dogs, finding that most agonistic facial displays are a composite of conflicting expressive intentions variably polarized along an aggression-fear continuum (Fig. 10.3). In fact, all threat displays, falling short of actual attack, are composed of both aggression and fear; otherwise, as Lorenz points out, aggressive dogs would simply attack without hesitation. Likewise, completely fearful dogs would just run away. Consequently, varying degrees of aggression and fear can be observed in the facial expressions of threat. A motivational analysis of these facial expressions reveals a dog's relative degree of threat and the dog's pending intentions. In Figure 10.3, the drawings at the top and bottom right-hand corners represent an imminent threat. The dog's expression depicted in the top right panel shows very little fear (the dominance aggressor), and the dog is prepared to attack without any further notice. The one located at the bottom right corner shows an example of an unstable equilibrium in which intense fear and escalating aggression collide (sharp-shy or *angstbeiser*) and, if pressed any further, the dog depicted here would certainly attack, especially if unable to flee from the situation. The dog in the center panel exhibits an equal amount of fear and aggression held in a conflict of stable equilibrium and, unless further provoked or intimidated by the local stimulus, will remain relatively stable between the two opposing motivational tendencies of aggression and fear.

These expressive motivational analyses clearly show that aggression and fear exercise a reciprocal modulatory (excitatory-inhibitory) effect on agonistic behavior. They indicate that moderate levels of fear may provide a beneficial influence on moderately strong aggressive impulses, whereas excessive fear in the presence of strong aggressive arousal may produce an undesirable dysregulatory effect—fear biting. In the case of aggressive behavior occurring without fear (e.g., dominance aggression), efforts to suppress it with punitive strategies that rely solely on the inhibitory effects of fear may only cause the aggressor to fight back even harder. In both instances, if the owner is unsuccessful, the

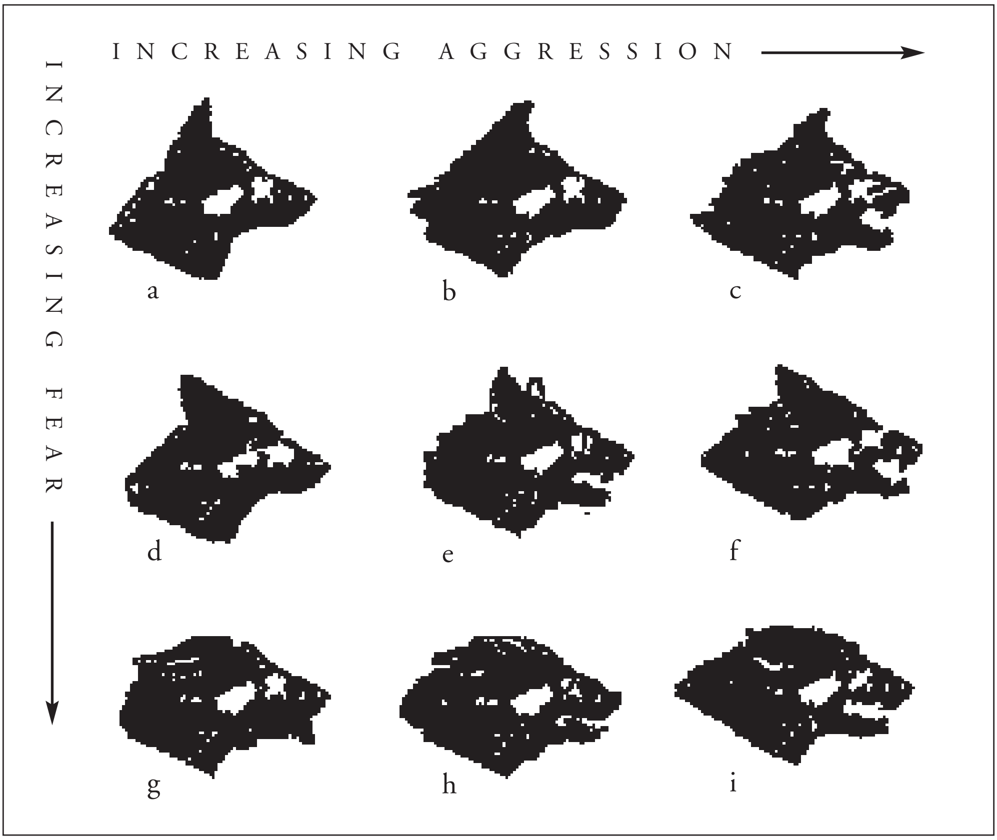

FIG. 10.3. Facial expressions of dogs showing the interaction of fear and aggression. After Lorenz (1966).

dog's behavior is instrumentally reinforced by escape-avoidance (defensive aggression) or positive reinforcement (offensive aggression).

In addition to facial expression, body posture and tail carriage are accurate indicators of a dog's changing moods and intentions. A stiff and erect tail indicates dominance and confidence, whereas a tail held low or between the legs shows fear and insecurity. The wag of a dog's tail has a wonderful and poetic range, giving the dog the means to fully express its emotional life or lack thereof. From elation to despair, the wagging tail tells all. Affection and enthusiasm are expressed through the dog's wagging and wiggling ear-to-rear smile. Similarly, at moments when high expectations are dashed by unanticipated disappointment, one can see the immediacy and sensitivity of a dog's expressive tail telling all that needs to be known about the dog's sorrowful dejection. Darwin tells an amusing story about a large dog he once owned that was especially fond of long walks. Sometimes as they set out on a walk, Darwin would stop by his hothouse to check the plants he was studying at the time. As a result, the dog learned to anticipate a frustrating delay as they approached the greenhouse, a letdown that immediately caused him to fall from a state of elated excitement into a cheerless flop. Darwin coined the expression "hothouse face" to capture the dog's striking change of mood and expressiveness:

> His look of dejection was known to every member of the family, and was called his *hothouse face*. This consisted in the head drooping much, the whole body sinking a little and remaining motionless; the ears and tail falling suddenly down, but the tail was by no means wagged. With the falling of the ears and his

> great chaps, the eyes became much changed in appearance, and I fancied that they looked less bright. His aspect was that of piteous, hopeless dejection; and it was, as I have said, laughable, as the cause was so slight. (1872/1965:60–61)

Although a happily wagging tail usually indicates a friendly intention, a wagging tail in the context of obvious threat is not to be trusted. Many highly aggressive and experienced dogs may actually look forward with some happy anticipation about the prospects of an aggressive contest or may experience some degree of conflict about the developing situation. A tail held high with a tight rapid wag is never to be trusted. The friendly, confident tail wag is a loose sweeping movement from side to side with various expressive undulations and shifts of direction. The friendly wag extends from the base of the tail, often including expressive bodily movements of the dog's rump as it twists side to side or tends to curl to one side or the other. In addition to providing visual signals, the tail wag may facilitate the transmission of various olfactory cues emanating from the anal and supracaudal glands (the latter is not present in all dogs).

In some common situations where dogs exhibit exaggerated tail wagging, the behavior may reflect a state of frustration or approach-avoidance conflict (Kiley-Worthington, 1976). During greetings, for example, a dog's locomotor tendency to move excitedly about is frustrated since it would carry the dog away from the object of affection and the benefits derived from staying close. Frustrated locomotion results in the expression of excited tail wagging, often including the dog's whole rear end. With regard to approach-avoidance conflict and tail wagging, such behavior is most characteristic of the subordinate in the presence of a more dominant figure, suggesting a pacifying function. Since fearful approach is usually characteristic of a subordinate animal, Kiley-Worthington concludes that tail wagging can be interpreted as indicating friendly intentions; but, as already noted, while this assessment is generally true, not all tail wagging invariably indicates friendly intentions. The expressive carriage of the tail provides the observer with valuable information about the dog's emotional state and eminent intentions (Fig. 10.4), but such information must be interpreted relative to other significant signals and the context in which they occur.

Cutoff Signals

An important social modulatory signal used by dogs to postpone or break off agonistic conflict is the so-called *cutoff* signal first described by Chance (1962). Such movements are often composed of escape intentions (turning the head/body to the side or closing the eyes), et-epimeletic intentions (quick nervous licking), or displacement activities (yawning). The cutoff action has been referred to as a compromise movement by Tinbergen and defined by him as a "movement caused by ambivalent motivation ... between two conflicting movements" (1964:216). In the case of agonistic encounters, the cutoff is an expressive compromise between fighting and fleeing. One apparent function of the cutoff movement is to suspend sensory contact momentarily with the arousing stimulus, thereby breaking off stimulation that might otherwise evoke a fight, while still avoiding a chase attack if the animal should attempt to run away. Besides the relaxing effects these signals have on the animal exhibiting them, they appear also to influence the opponent to reciprocate in kind, leading to a mutual compromise. Leyhausen had this pacifying function in mind when he wrote about these secondary effects of cutoff actions:

> Such behavior, however, indicates that, on the one hand, an animal is not prepared to yield but also that, on the other, it is not for its part in an aggressive mood. Such a gesture of severing contact contains an offer of peace as well as a warning to the other not to push matters to the limit, and this is the effect it often produces, i.e., in many animals there are appropriate receptive IRMs [innate releasing mechanisms]. (1973:304–305)

The cutoff signal is not a submissive gesture but an opportunity to call a draw and walk away without further conflict and potential injury to the contestants.

Occasionally, a wolf will expose its neck to

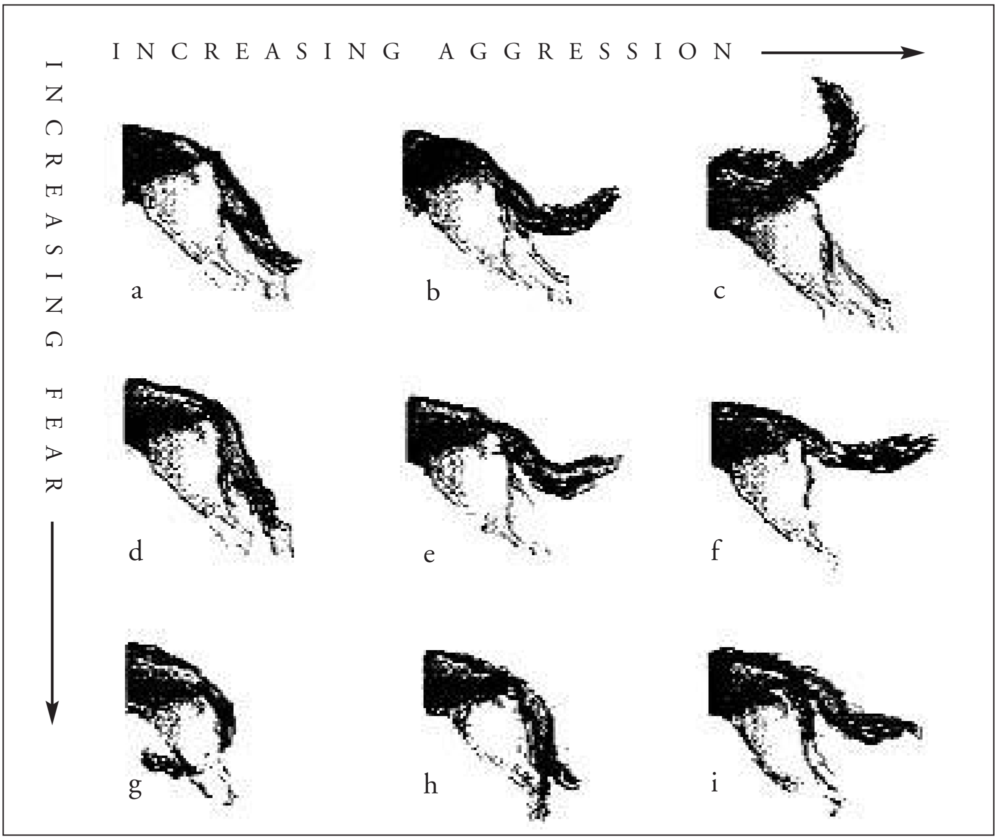

FIG. 10.4. Tail carriage showing the interaction of fear and aggression in dogs. In combination with expressive facial displays and posture, the carriage of a dog's tail communicates the dog's emotional state and behavioral intentions.

a rival as a ritualized agonistic movement. Konrad Lorenz (1966) has argued that both dogs and wolves present the neck as a submissive appeasement gesture, a ritualized expression of nonaggression in which the weapons (teeth) are turned away from the opponent while the most vulnerable part is exposed to the opponent. Schenkel (1967) has argued that this interpretation is flawed, insisting that it is always the *submissive* animal whose teeth are nearest the exposed neck of the dominant—not vice versa. The posture is not submissive but a confident taunt and challenge to an overly ambitious subordinate. According to Schenkel, what Lorenz viewed as a submissive posture is actually a threat display and challenge exhibited by a dominant, not subordinate, animal. Rather than representing a submissive intent, the exposed neck posture is more likely a statement to the effect "I'm not much interested in fighting you right now; but, nonetheless, go ahead, I dare you to make a move." Fox (1969) has emphasized the pacifying effect of the neck display, arguing that the movement is not presented by the dominant wolf as a challenge or dare, but rather it is offered as a pacifying or calming movement intended to curtail the subordinate's agonistic adventure before it escalates into a more serious conflict. Finally, Scott claims that he has never observed a subordinate dog expose its neck as an act of deference to a dominant aggressor; instead, the subordinate is much more likely to assume a defensive and self-protective posture: "Instead of the jugular vein, the dominant dog is most likely to be presented with a mouthful of snapping teeth" (1967:379).

Effect of Domestication on Social Communication

As the result of domestication, many morphological and behavioral changes have occurred that have altered the dog's ability to communicate through facial and bodily expressions. Many of these changes have resulted from genetic alterations in the direction of relative immaturity or physical and behavioral *paedomorphosis*. Dogs never fully mature but remain in most respects at a developmental stage resembling that of a juvenile wolf. Frank and Frank (1982) have argued that the process of domestication proceeds along various paedomorphic lines, with selective pressures yielding prolonged immaturity and various corresponding behavioral changes. In the transformation from *lupus* to *familiaris,* wolves lose many of the well-defined agonistic rituals that ordinarily promote close and cooperative social interaction. They note that "the wolf's highly predictable dominance ritual has disintegrated into an assortment of independent behavioral fragments" (1982:519). However, not only have dominance displays undergone change, submission displays have also degenerated under the influence of domestication: "His submission responses have likewise lost much of their adaptive function and, consequently, their behavioral integrity and social significance; a domestic dog on his back is more probably soliciting attention than initiating submission or responding to domination" (1982:519). In the place of clearly defined and unambiguous signals has arisen a collection of generalized signals that promote social promiscuity through exaggerated care-seeking behaviors, various active and passive submission fragments, and the perpetuation of a juvenile tolerance for varied and close social contact. In comparison with the wolf's highly organized and integrated social structure, the dog appears disjointed, confused, unpredictable, and fragmented.

Besides these general effects of domestication, breed-specific changes have affected the dog's social behavior in many ways. Selective breeding has altered developmental rates, behavioral thresholds for the display of dominant and submissive behavior, behavioral tendencies and temperament traits, social bonding, and trainability. Goodwin and colleagues (1997) attempted to quantify the domestic dog's divergence from the lupine archetype and communication system based on morphological changes, bodily gesture and posture, and facial expression. Their study demonstrates that the dog's ability to communicate has gone through significant change as the result of domestication, at least insofar as human observers are concerned. Among the breeds compared, dogs whose appearance most resembles the wolf (e.g., German shepherd and Siberian husky) exhibited a corresponding greater number of wolflike signals exhibited during agonistic interactions than did dogs whose appearance was deemed dissimilar to wolves (e.g., cavalier King Charles spaniel, Norfolk terrier, and French bulldog). Among wolves, these signals are used to modulate agonistic interactions and to prevent an escalation of aggression. One would assume, therefore, that in dog breeds without an effective agonistic signaling system that they would be more prone to engage in conspecific aggression, but this does not appear to be the case. The authors speculate that dogs have a much higher threshold for aggression and, consequently, they do not require the more intricate social communication devices exhibited by wolves. Also, dogs may rely on more subtle communication devices for the management of agonistic behavior that remains to be more fully elucidated.

The Question of Animal Awareness

Viable social communication between humans and dogs implies that there exists some degree of conscious awareness or, at least, empathetic sensitivity mediating the exchange, but does a genuine sense of empathy or self-awareness exist in the mind of the dog or is such a supposition a projection of human imagination? The fact that dogs and people enjoy each other's company and form lasting affectionate bonds raises several important questions: Do dogs have a private personal experience analogous to human consciousness? Do dogs experience feelings similar to those of their keepers? Is there an evolution-

ary continuity of conscious experience shared by both species? A negative response to any of these questions would greatly diminish the worth of the social bond existing between the two species. Concluding that dogs lack conscious awareness and empathetic sensitivity would imply that the social exchange is one-sided (at least in terms of conscious awareness and empathy)—a kind of social onanism rather than a true relationship in the usual sense of the word.

The Western philosophical tradition equates consciousness with the ability to use language. According to this view, *knowing* and *thinking* depend on a shared language through which knowledge and thought are exchanged and confirmed or denied. The presence of consciousness is attributed to someone based primarily on the existence of such language-mediated exchange. However, language-based exchange alone can hardly prove beyond all shadow of doubt that consciousness actually exists in others as it does in oneself. The phenomenon of consciousness is preeminently a private experience whose existence is hard to define or prove to exist. We can only "guess" or assume that consciousness exists in other people (or animals) by inference from our own personal experience of consciousness and the world. But just because we cannot *prove* that others are conscious in the same sense that we are, it hardly follows that we are therefore logically compelled to deny or seriously question the reality of their consciousness. On the contrary, the shared or public nature of consciousness is not questioned at all, but we all proceed with our affairs as though others are approximately as self-aware and conscious as we are and motivated in a similar manner—at least, until we discover evidence to the contrary.

Although it would seem reasonable to apply a similarly pragmatic paradigm to the study of animal awareness and cognition, the notion of animal awareness is highly controversial. The rejection of animal awareness arose within the context of the Judeo-Christian tradition and, in particular, Cartesian rationalism, which explicitly denied the existence of animal awareness. According to Descartes, animals are no more than animated organic automatons, programmed like a machine to perform and function as they do without conscious awareness or rational intent. An animal's appearance of conscious deliberation and sensitivity is an illusion on the same order as that exhibited by a mechanical robot. Describing the Cartesian perspective, John Passmore writes, "What we hear as a cry of pain is of no more significance than the creaking of a machine," and continues,

> These teachings, it should be observed, were more than metaphysical speculations. They had a direct effect on seventeenth-century behavior as manifested, for example, in the popularity of public vivisection, not as an aid to scientific discovery but simply as a technical display. "They administered beatings to dogs with perfect indifference," so La Fontaine, a contemporary observer, tells us, "and made fun of those who pitied the creatures as if they had felt pain. ... They nailed poor animals up on boards by their four paws to vivisect them and see the circulation of the blood which was a great subject of conversation." (1975:204)

The resistance to the idea of attributing consciousness to dogs or other animals is complex. Our cultural resistance to the idea probably rests more on moral and ethical grounds than it does on scientific or philosophical ones. If we attribute awareness and sensitivity to animals of a similar kind and extent to our own experience, we are then thrust into an uncomfortable moral dilemma stemming from the various uses we make of animals (Carson, 1972). To subjugate, kill, or experiment on an animal that is unaware of its plight is ethically very different from performing the same actions on a fully sentient and sensitive being. Together with the attribution of awareness to animals comes an ethical imperative that may be simply too hard for many of us to accept or one that is perceived to be economically untenable. Whatever the case may be, by concluding and accepting that animals are endowed with a private experience or self-awareness comparable to our own, we are brought face to face

with a moral crisis that would revolutionize how we view and treat animals under our care.

Understandably, given what is at stake, the debate surrounding the existence or nonexistence of animal awareness is sometimes a heated one. This state of affairs is unfortunate, since, as Donald Griffin (1981, 1984, 1992) has argued for many years, animal awareness and cognition should be approached with the same cool scientific scrutiny and systematic study that other natural phenomenon are investigated. For such study to proceed, though, one must first concede that animal awareness and cognition might exist to some degree—otherwise there is no object of study. The burden of proof then shifts to an examination of the extent to which animal awareness exists based on accepted scientific criteria and standards.

Historically, the study of animal awareness and cognition has been almost fully neglected, but new interest in the subject has appeared with the publication of a series of important books and articles by Griffin and others (Regan, 1983; Walker, 1983; Burghardt, 1985; Bekoff and Jamieson, 1996). Griffin (1981) has attempted to develop a scientific basis and discipline (*cognitive ethology*) for the study of animal awareness. He has argued strongly in favor of an "open" mind with regard to the hypothetical existence of consciousness and subjective self-awareness in animals:

> If we take for granted that our own mental experiences are real and significant, it seems more likely than not that because the central nervous systems of other animals are basically similar, they will share with our brains the capability of making possible at least some kinds of mental experiences. To conclude that nothing of the kind ever happens requires that we postulate an unparsimonious qualitative distinction between human brains and all those others that seem to have such similar structural and functional properties. (1981:167)

Temple Grandin (1995) has suggested that animal awareness and *thinking* be viewed as a kind of perceptual activity based on direct sensory information and memories. Human thinking is distinguished from animal thinking by the reliance of human thinking on symbolic representations and abstract concepts. According to this viewpoint, dogs, somewhat akin to the thinking style of artists or musicians, consider things primarily in terms of their immediate sensory significance (e.g., smells, sounds, sights, and tactile sensations), relevance to the animal's current motivation state, and associated memories brought to the situation. Awareness poises the animal for effective action within the context of a changing environment.

In the early 1930s, Otto Tinklepaugh (1934) warned comparative psychologists not to fall victim to what he termed a widespread and growing anthropomorphic phobia. He observed that many researchers in their fear of appearing anthropomorphic have arbitrarily renamed and redefined animal behaviors so as not to be accused of anthropomorphism. In Tinklepaugh's opinion, this subterfuge is "comparable to differentiating between the 'sweating' of a monkey and the 'perspiring' of man." He continues,

> Other investigators, for similar reasons, have avoided stating their honest convictions concerning the behavior they have observed. The purposes of science demand accurate observation, accurate description, and, where possible, logical interpretation. Though all interpretation is subject to modification or even to reversal, no one is in as good a position initially to evaluate the various factors that enter into an investigation, and to interpret the results, as is the collector of the data. The anthropomorphic phobia has no place in scientific psychology. (1934:507)

Cognition Without Awareness

Despite Tinklepaugh's encouragement, most behavioral scientists have found it expedient to exclude notions like *animal awareness* and *animal minds* from their investigations but without necessarily denying that they exist. For the most part, this rejection is justified simply because such phenomena do not yield amiably to controlled manipulation and di-

rect measurement. Furthermore, the addition of an intervening variable like *consciousness* offers little theoretical advantage to their studies but does add considerably to the complexity of the subject matter. This appears to be exactly the position that Niko Tinbergen adopted, writing that although "the ethologist does not want to deny the possible existence of subjective phenomena in animals, he claims that it is futile to present them as causes, since they cannot be observed by scientific methods" (1951/1969:5). According to Tinbergen, the study of subjective states (e.g., hunger, fear, anger, and sleepiness) is the domain of physiologists—not psychologists. Apparently, what is needed is an operational definition of consciousness formulated in experimental terms and the intellectual freedom to study it without suffering the accusation and stigma of anthropomorphism.

Recent trends in animal behavior research have turned toward the careful analysis of cognitive functions but without necessarily agreeing about the existence of animal awareness or what that might mean (Vauclair, 1996). In the study of animal behavior and learning, the existence of animal awareness is often implied (but not explicitly articulated or even presumed by researchers) as a precondition for adaptational adjustment between the organism and the environment. This is especially evident in cases where adaptation depends on cognitive functions like prediction, expectation, and choice between alternative courses of action—cognitions implying the existence of conscious deliberation.

As already discussed in detail (see chapters 6 and 7), many leading contemporary learning theorists have adopted various *cognitive* hypothetical constructs in an effort to make theoretical sense of their experimental findings. Robert Rescorla (1988), for instance, has found that many acquisition and extinction phenomena involving classical conditioning cannot be adequately understood in terms of the traditional Pavlovian conventions alone but require the additional implementation of various cognitive constructs in order to be fully explained. Classical conditioning is not merely the mindless connecting of a conditioned stimulus (CS) with an unconditioned stimulus (US), so that the CS gradually comes to elicit a response similar to the one elicited by the US. In addition to the mere physiological effects and stimulus-response associations obtained by pairing the CS with the US, an animal also learns about various interdependent *relationships* between CS and US. According to this viewpoint, classical conditioning is a cognitive or *mental* activity aimed at securing a viable and continuously updated environmental interface and adaptation.

This general line of reasoning conforms with the cognitive emphasis suggested by the pioneering learning theorist Edward Tolman (1934). In opposition to the majority of early behaviorists, Tolman proposed that learning be studied experimentally from a cognitive perspective. He suggested that animal learning be studied as an interpretive and purposive activity taking place within a cognitive field of "sign-gestalt expectations." As might be expected from the foregoing, interest in Tolman and other gestalt theorists (e.g., Piaget) have enjoyed a recent resurgence of attention, especially among comparative psychologists.

Empathy and Awareness

The subtle social communication occurring between humans and dogs seems to imply that there exists a shared cognitive or empathetic substrate mediating, assessing, and evaluating mutual intentions and meaning, as well as deliberating on different possible courses of action based on parallel appraisals and emotions experienced by the affected communicators. That is, meaningful communication would appear to require an internally represented and empathetic experience of the other. Grandin (1995) has emphasized the importance of such empathetic identification for the ethologist attempting to connect with and truly understand an animal under observation and study.

The mammalian limbic system has been identified as the area of the brain evolved to interpret and experience emotion, making it a likely area where social learning, bonding, and affectional attachment take place. Paul MacLean (1986) found that mammalian ma-

ternal behavior, separation-distress vocalization, and play are organized at the level of the cingulate gyrus, an important part of the limbic system. The cingulate gyrus is the structural dividing line between the reptilian and mammalian brains. Furthermore, it is reasonable to assume that a brain system involving the cingulate gyrus provides the common neural matrix for empathetic exchange and reciprocal attachment between mammals, especially between humans and dogs. The functional and morphological similarity of this neural structure may determine the potential depth and range of social bonding between mammals. The analogous behavior and intention apparent between humans and dogs is not necessarily an anthropomorphic conceptualization but a profoundly experienced similarity based on an instinctual need for closeness, nurture, care giving and receiving, emotional expression, and play.

K. J. Shapiro (1990) proposed that the communication gap between humans and dogs can be bridged by a method he calls *kinesthetic empathy*. In a paper presented at the American Psychology Association Convention in Atlanta in 1988, he took a radical departure from the conventional rejection of anthropomorphic speculation and espoused a *phenomenological method* for assessing the experience of others, including the other as experienced by dogs:

> A kinesthetic empathy, consisting of the meaningful actual or virtual imitation or enactment of bodily moves, is possible. It is possible because we both have living, mobile, intending bodies. ... Empathy is the direct apprehension of the intent, project, attitude, and experience of the other. ... More generally, I can also directly apprehend your or a dog's project, purpose, or anticipated intent. ... Empathy is a general access to the intended world of the other. (1990:191)

According to Shapiro, empathy does not depend on inference, form, analogy, self-identification, or "body complementarity" with the object of empathy; rather, empathy occurs as the result of "a moment in which I, if only focally, forget myself and directly sense what you are experiencing." Unfortunately, Shapiro's method raises many questions and problems that he fails to address adequately, especially with respect to the control of empathetic errors due to anthropomorphism and cultural biases influencing ones empathetic perceptions.

Mysticism

Some authors and poets have attempted to extend interspecific communication and empathy beyond the scientific realm to the level of spiritual union and identity—what Rilke has termed *inseeing*:

> I love inseeing. Can you imagine with me how glorious it is to insee, for example, a dog as one passes by. To insee (I don't mean inspect, in which one immediately comes out again on the other side of the dog, regarding it merely, so to speak, as a window upon the humanity lying behind it, not that)—but to let oneself precisely into the dog, the place in it where God, as it were, would have sat down for a moment when the dog was finished, in order to watch it under the influence of its first embarrassments and inspirations and to know that it was good that nothing was lacking, that it could not have been better made. ... Laugh though you may, dear confidant, if I am to tell you where my all-greatest feeling, my world-feeling, my earthly bliss was to be found, I must confess to you: it was to found time and again, here and there, in such timeless moments of this divine inseeing. (Quoted in Woloy, 1990:47)

These efforts reveal both the potential benefits, as well as the excesses, of the foregoing *empathetic method* described by Shapiro. J. Allen Boone (1939, 1954), an early proponent of the method, has described a visionary process of empathetic exchange between him and the dog Strongheart, a famous police dog and canine actor. He recounts his discovery, writing in *Kinship with All Life*,

> What made our silent conversations so easy and so rewarding was the invisible Primary Factor that was responsible for the entire activity. In order to understand this deeply hidden secret, it is important to know that what actually went on in those communion sessions of ours was not the hit-or-miss exchange of thoughts between the "larger and more important brain of a human" and the "smaller and less important brain of a dog." Not at all. Brains as such had no more to do with it than ribs. And that something had all the love of the

> boundless Mind of the Universe moving back of it and in it and through it.
>
> Neither Strongheart nor I was doing any communicating as of ourselves. Neither of us was expressing himself as an original thinker or an independent source. On the contrary, we were being *communicated through* by the Mind of the Universe. We were being used as living instruments for its good pleasure. The primal, illimitable and eternal Mind was moving through me to Strongheart, and through Strongheart to me. Thus I came to know that it moves through everything everywhere in a ceaseless rhythm of harmonious kinship. (1954:76)

The evident experience of harmony and silent interpenetration between Boone and Strongheart reaches ecstatic proportions. Boone believed that he had formed with Strongheart a spiritual conduit for directly experiencing the sacred rhythms of nature:

> Thus did Strongheart and I share in that silent language which the Mind of the universe is constantly speaking through all life and for the greater good of all life. Thus did we make use of that wondrous inner route from mind to mind and from heart to heart. Thus did we cross each other's boundaries, only to find that there were no boundaries separating us from each other, except in the dark illusions of the human senses. (1954:80)

Boone thought that he had discovered a dormant potential for interspecies communication and understanding. The relationship consequently established between himself and Strongheart was full of meaning, vitality, and urgency. According to Boone, a contemplative link is always available and accessible through earnest and sincere recognition of the fundamental equality of human and dog existence—a recognition and experience that is fully obtained at any moment through the vehicle of a pure and sincere heart or what Shapiro refers to as "the direct apprehension of the intent, project, attitude, and experience of the other" (1990:191).

In the 1930s, Boone lived in a period of social and economic turmoil in which the world seemed to be falling apart. His personal search for meaning took him on a journey around the world. During this odyssey, he composed his *Letters to Strongheart*—an outpouring of love and respect for his lost friend who had died. An important goal of the book was to place the dog's cultural role and purpose into a new perspective. For Boone, the dog was a salutary spiritual influence, perhaps our only hope of coming to our senses before destroying ourselves. In his estimation, the dog embodied the perfected traits of nobility, sincerity, devotion, unselfishness, strength, honesty, and pure enthusiasm for life. In essence, the life of the dog is a poetic expression of profound virtue and meaning:

> He composes a poem by turning himself into a poem, from the tip of his nose to the tip of his tail. The human writes poetry. The dog lives poetry. And who among us, in a Cosmos in which so much of reality has yet to be discovered, is qualified to say whether the human or the dog method of self-expression is nearer the ultimate of reality. (1939:111)

For Boone, "good poetry is any dog doing anything." Beyond the dog's physical form and materiality, Boone believed existed a spiritual essence waiting silently to guide our edification and improvement.

While traveling in Japan, he had the opportunity to attend a tea ceremony. At the conclusion of tea, he asked the tea master how one might find the greatest satisfaction in life. The host replied, "By disciplining one's self, and learning to live divinely in small as well as great things." Boone then asked the master to describe some of the characteristics of the superior life. The list of attributes included various qualities and traits, such as love, contentment, unselfishness, appreciation, loyalty, sincerity, simplicity, frugality, gratitude, self-control, the capacity for small enjoyments, serenity, honesty, poise, genuineness, courage, sympathy, tolerance, understanding, good manners, strong observation, strength with gentleness, unselfish attitudes, dignity, and the ability to be interested in people and things for their own sakes and not for personal return. Boone further inquired of the master what would one be called who possessed all of those characteristics. The master replied that such a person

would be regarded as an *enlightened one*. A Japanese guest having tea with Boone then asked him whether he had ever known such a person. Boone confirmed with a nod that he had, and the following dialogue between the two ensued:

> "An American?" he queried, enthusiastically.
> "Only by adoption," I told him. "His name is Strongheart."
> "An Indian!" he exclaimed like a puzzled child.
> "No," I said, "most people call him a dog." (1939:88)

The dog is a familiar image in Buddhist mystical symbolism and philosophy, especially those teachings belonging to the Zen sect, and Boone's koanlike comment would have surely produced a strong impression on those present. Even in Japan today, the Zen initiate is frequently tested with a koan that has a dog as the subject of consideration. In fact, the most famous koan of all is the one based on the story of the 9th-century Chinese Zen master Chao-chou (or Joshu) in Japan. Joshu was asked by a petitioning monk whether dogs possessed a Buddha nature; the Master replied without hesitation, "Mu." The word *Mu* is variously translated as "no" or "nothing," but this literal interpretation fails to convey the term's intended meaning or the various spiritual nuances associated with it in this context. Joshu's reply is not a simple denial of the dog's Buddha nature, nor can it be interpreted as an empirical statement about dogs. In fact, Joshu's Mu is intended to defy and defeat rational understanding and explanation. Instead of thinking about the koan's rational meaning, seekers are urged to abandon reason and approach it with their whole being (like Boone's dog poet), not relying on intellectual support or guidance. The meaning of Mu is attained only after exhaustive internal search and meditation. Gradually, through the influence of rigorous training and self-control, and provided that the seekers are able to forget the self, they are brought face to face with Mu as a direct revelation. This state of mind transcends the ordinary web of appearances and dualistic individuation, and moves into a realm of nondifferentiation where both denial and affirmation are equally meaningless. A realm where dog and seeker are no longer two, but one embraced by the all-encompassing Mu. Here, the seeker dissolves into the dog, dog into seeker, dog and seeker into Mu, and Mu into the quietude of emptiness. This transformation and intercommunication between human and dog is more or less the central theme of Boone's spiritual quest.

Michael Fox (1980), a prominent animal behavior researcher, veterinarian, and psychologist confides that he experienced the wolf, not only as the object of scientific research and analysis but also as a "teacher and mirror" guiding him to a higher understanding of himself and mediating a closer relationship with nature. He felt that this inner recognition and heightened awareness was given to him through a mystical union with the wolf but only after the arbitrary barriers separating him from the wolf were dissolved and replaced with a direct intuitive vision and apprehension of the wolf as a living being—a soul: "Man and wolf are not only of one earth, but they are also of one essence" (1980:4). The outcome of this visionary experience for Fox was the birth of an empathetic kinship with the wolf and a "common ground within the essence of life."

Despite the discomfiture that such ideas may cause some scientifically inclined readers, dogs and other animals have served and continue to serve an important spiritual function in the psychic life of modern humankind. Whether such a spiritual function played a role in the early bonding process between humans and dogs during primitive times is not clear, although it is known that dogs were frequently buried with their owners, ostensibly serving as guides into the spirit world. Shamans of living tribal cultures often make use of helping spirits in the form of wolves or dogs, as well as other animals (Eliade, 1964). Before setting off on their ecstatic journey, Chukchee and Eskimo shamans turn themselves into wolves—a transformation that enables them to move freely through the depths and heights of nature. The shamanic experience is not intrinsically different from the foregoing testimony of Boone and Fox: the

animal as a helping spirit mediates a more profound union with nature and oneself. According to Jungian analyst Eleanora Woloy (1990), dogs provide modern humankind with a vital contact point with nature. Under the dehumanizing influence of alienation—isolated from both nature and one's instincts—dogs offer a comforting source of reunion on both levels. In addition to practical considerations, the ancient covenant between humans and dogs served both a symbolic and mythical function, embodying the ideals of faithfulness, devotion, trust, love, protection, and cooperative submission for the greater good.

Dog Devotion: Legends

The close bond between people and dogs has been the perennial subject of poetic and literary idealization throughout history. One of the most poignant examples of this literature comes from an ancient Hindu text, the *Mahabharata* (Mally, 1994). Purported to be the oldest dog story, it recounts the celestial journey of a Brahmin king and his dog to heaven. The spiritual passage is filled with strife and danger, with the old Brahmin losing all of his earthly friends and family along the way—all except for his faithful dog. When at last he reaches his destination and stands before the portals leading to ultimate liberation and bliss, Indra appears before him and blocks the way:

> The celestial doors were opened for him, but his weary, long suffering, and steadfast old hound might not enter! Yudishthira saw within the walls the glories of Heaven; he saw, too, the faithful, gaunt dog cowering at his feet and gazing pleadingly up into its master's eyes; the king's heart was torn with longing and gratitude.
>
> "O Wisest One, Mighty God Indra!" he cried, "this hound hath eaten with me, starved with me, suffered with me, loved me! Must I desert him now?"
>
> "Yea," declared the God of Gods, Indra, "all the joys of Paradise are yours forever, but leave here your hound."
>
> Then exclaimed Yudishthira in anguish.
>
> "Can it be that a god can be so destitute of pity; Can it be that to gain this glory I must leave behind all that I love? Then let me lose such glory forever!"
>
> And Yudishthira turned sadly toward his forlorn dog. But the mighty Indra called to him again.
>
> "Do you not understand? The creature is unclean; it would defile the altar fires of Paradise! Know this indeed: into Heaven, such cannot enter."

The Brahmin king could not be persuaded to abandon his dear friend but proclaims the injustice of leaving his devoted dog behind after all the many travails they had suffered so long together. The supplicant king would not betray his innocent dog even if it meant losing eternal bliss. Instead, he turns away, saying "Farewell, then, Lord Indra. I go and my hound with me." Just as he speaks these words, the dog is transformed into the god Dharma (Justice), who proclaims,

> "Behold, son, you have suffered much! But now, since you would not enter Heaven lest your poor dog should be cast away, lo! there is none in Paradise shall sit above you! Enter. Justice and Love welcome you."

In Homer's depiction of the reunion of Odysseus with his old dog Argos, the warrior king, after a 20-year absence, finds his neglected dog Argos near death "half destroyed with flies" and lying prostrate on a dung heap. In spite of the many intervening years, and the dog's weakened state, Argos still recognizes his master hidden under the cloak of a beggar. The old dog, mirroring his master's plight, collects his last bit of strength "to wag his tail, nose down, with flattened ears," but collapses before he can reach his master's hand. Odysseus wipes away a tear as his old friend dies in disgrace. Plutarch tells a similarly moving story that further underscores the Greek's appreciation of the dog's special attachment and devotion to humans. During the Persian War, all able Athenians were recruited and forced to leave their families to fight the invading Persian forces:

> When the whole city of Athens were going on board, it afforded a spectacle worthy of pity alike and admiration, to see them thus send away their fathers and children before them, and, unmoved with their cries and tears, pass

> over into the island. But that which stirred compassion most of all was, that many old men, by reason of their great age, were left behind; and even the tame domestic animals could not be seen without some pity, running about the town and howling, as desirous to be carried along with their masters that had kept them; among which it is reported that Xanthippus, the father of Pericles, had a dog that would not endure to stay behind, but leaped into the sea, and swam along by the galley's side till he came to the island of Salamis, where he fainted away and died, and that spot in the island, which is still called the Dog's Grave, is said to be his. (*Plutarch's Lives: Themistocles*)

Many other examples of extraordinary devotion and attachment leading up to modern times could be recounted, but a particularly noteworthy one in this regard is the story of an Akita: Hachi-ko (Coffman, 1997). The story tells how the dog routinely greeted his owner (a professor at Tokyo University) at 3:00 PM every afternoon at the Shibuyu subway station. One fateful day, however, the dog waited in vain, since the professor had suffered a fatal stroke while at school that day. Undaunted, the determined Hachi-ko went back to the station day after day to await the belated return of his lost master. As a result of his extraordinary fidelity and determined steadfastness, Hachi-ko became a Japanese cultural icon during his lifetime (1922 to 1934), with visitors coming from all over the country just for the opportunity to pet the famous dog. A bronze statue was erected in his honor bearing testimony to his devotion and long vigil. After 9 years of waiting, the dog finally collapsed and died of old age at the base of the statue dedicated to his memory.

Cynopraxis: Training and the Human-Dog Relationship

Michael Fox (1979) has identified and described various functions served by dogs and the corresponding relationships formed between humans and dogs as a result of those roles. The interactions between humans and dogs range from indifference to close companionship and a heightened sense of responsibility or stewardship. These roles and values are organized within a hierarchical system that moves from an object-oriented exploitive relationship to an appreciation of dogs for their own sake, a level of interaction that Fox refers to as *transpersonal relatedness*. On the transpersonal level, dogs are appreciated for what they are rather than for the emotional or utilitarian gratification that they might provide. At the lowest rung of this hierarchy are dogs exploited for some utilitarian purpose such as a family pet for children or dogs specifically trained for practical purposes. Under the heading of utilitarian-exploitation, Fox includes dogs used for laboratory research as well as dogs trained for work (e.g., hunting, shepherding, guarding, pulling, search and rescue), competitive uses (e.g., conformation, agility, obedience), military and police dogs, and service dogs of all kinds. Most of these various roles and functions include both exploitive purposes and emotional dependencies which the dogs are expected to serve. On the level of transpersonal relatedness, dogs are valued for their intrinsic worth—not for some remote purpose. In addition to valuing dogs for their own sake, Fox emphasized the importance of a heightened sense of responsibility, the highest level of interaction, which he refers to as stewardship. *Stewardship* refers to a refined concern for a dog's well-being and quality of life based on an appreciation of the dog from the perspective of transpersonal relatedness.

Obviously, there exist many purposes for which the dog's behavior is modified by training, ranging from utilitarian interests to improved household manners. Aside from practical considerations, a central goal of the training process is to enhance the human-dog relationship by promoting interactive harmony and interspecies appreciation, while at the same time striving to raise the dog's quality of life, that is, the trainer assumes the responsibility of stewardship in his or her dealings with a dog. Behavioral intervention that emphasizes these values is here referred to as *cynopraxis.* The term is composed of two Greek roots: cyno (*kunos*) or "dog" and praxis (*prassein*) "to do." *Praxis* refers to the application of theoretical knowledge for some practical purpose. In the present context, it refers

to the application of ethology, learning theory, and supporting areas of scientific research (e.g., neurobiology) to the humane management and control of dog behavior. However, these characteristics only provide a partial picture of the meaning and character of praxis and the cynopraxic process.

Aristotle used the term *praxis* in the *Nicomachean Ethics* (Irwin, 1985) with three interdependent meanings that have relevance for understanding cynopraxis as a canine behavioral art. Praxis is voluntary and goal directed, regulated by informed and rational choice, and performed as an end in itself. According to Aristotle's teachings, virtuous action (voluntary, rational, and an end in itself) inevitably results in *happiness*. Similarly, cynopraxic intervention strives to attain harmonious and *joyful* coexistence between humans and dogs through a similar triadic scheme of intervention. Central to this purpose is the exercise of effective behavioral control and management, which is attained through actions guided by rational purposiveness. Herein lies the importance of science and sound practice for the cynopraxic trainer and counselor. However, to achieve these goals, the cynopraxist, in addition to exercising rational objectivity and ethical restraint, embraces subjective sensibilities that infuse the cynopraxic arts with a distinctive *feeling* dimension. Finally, the cynopraxic process is an end in itself, insofar as there are no training goals or objectives for cynopraxists that exist beyond the attainment of interactive harmony between human and dog.

Cynopraxic intervention takes place within the context of a family-pack system and home, with the express purpose of improving the human-dog relationship and the overall quality of a dog's life. Although the cynopraxic process operates under the preemptive constraints of scientific behavior theory, it strongly emphasizes the value of *subjective* and *dynamic* factors that influence the formation and maintenance of the bonding process. Consequently, in addition to generalizable *data*, cynopraxists address highly individualistic or *intimate* (Lat. *intimus* or "inmost, deepest") influences that contribute to the intensification of the human-dog bond. Specifically, cynopraxis embraces and promotes the value of play, esthetic sensitivity, emotive-cognitive empathy, intuition, compassion, and ethical constraints; that is, subjective attributes that are shunned by a strictly scientific analysis. In effect, cynopraxis places scientific knowledge into the perspective of a humane and *feeling* art, with the explicit and self-limiting goals of fostering social harmony and well-being through informed training and counseling. Achieving these ends may require that some minor or major modification of a dog's behavior and surroundings takes place, but such modifications are justified only to the extent that they serve these dual cynopraxic purposes. Cynopraxists view behavioral adaptation as an epigenetic process involving various biobehavioral predispositions interacting with learning experiences (e.g., development, socialization, and training)—all taking place within the context of a social relationship and home environment. Consequently, behavior adjustment problems are analyzed in terms of their functional significance and relation to a dog's relative ability or failure to form satisfying relationships or to occupy a common domestic environment harmoniously with human or other animal companions. In general, the cynopraxic arts address dog behavior problems as obstacles blocking the way to the formation of a more satisfying and joyful human-dog life experience and interspecies appreciation. Although the establishment of control is often necessary and desirable, behavioral control for the sake of domination or for the sake of objectives harmful to the dog or degrading to the human-dog bond is inconsistent with cynopraxic philosophy. Cynopraxic trainers are distinguished by an attitude of composure (mental and physical), presence, and sincerity of purpose that informs their actions—personal qualities that mediate connectedness with the dog and facilitate the bonding process. Cynopraxic intervention guides behavioral change through the augmentation of affection, communication, and trust.

The perennial bond between humans and

dogs has always involved some balance of companionship and work. Cynopraxists recognize and appreciate the importance of cooperative activity between humans and dogs; however, training activities that place a utilitarian purpose or objective above the human-dog relationship or employ dogs in activities that threaten their safety and welfare fall outside of the cynopraxic scope of practice. Practical dog training for competition, entertainment, service, or work may conflict with cynopraxic interests, depending on the specific purposes of such training and other considerations associated with such activities. Obedience training, in the sense of the Latin root, *oboedire*, or the act of "listening to," exercises a profound mediating influence between humans and dogs. The locus of obedience training resides within a shared human-dog moment of intensified attention and recognition of each other, with the purpose of promoting mutual understanding, cooperation, and refinement of interaction. Obedience training, as such, is an instrumental cynopraxic tool for enhancing interactive harmony and appreciation. From the cynopraxic point of view, training and the bond formed as a result of training are coextensive and mutually dependent on each other. In total, the training process begins and ends as a celebration of the human-dog bond and its actualization. However, practical dog training that strives to establish control for the sole purpose of dominating a dog or in order to exploit its labor and services is demeaning and destructive of this unique bond and its potential. In essence, such training exploits the bond in order to achieve remote purposes or objectives beyond it, a process that is ultimately alienating for both trainers and dogs. Under the influence of such training, dogs are gradually transformed into tools or weapons, while the trainers run the risk of losing their moral center in the process. Further, when a dog's services are no longer needed or useful, it may be "officially" stripped of life and sentiency (the very characteristics that made its training possible in the first place), thus degrading it to the status of an inanimate object or piece of surplus equipment unworthy of special care or protection beyond that given to other things that have become obsolete or useless.

A military working dog, for example, typically forms a profound connection with its handler as a result of training, but this training may also require that the dog learn to perform tasks that add nothing to the bonding process or to the dog's quality of life. In fact, such dogs are often deliberately exposed to danger and harm as a direct result of performing the services for which they are trained. The following examples will help to clarify some of these concerns. During World War II, Russian war dogs were trained to run under enemy tanks with explosives strapped to their backs. These dogs were transformed into living bombs by exploiting their affection and trust. Not only are the dogs at risk of danger and harm, so is the fundamental bond between the handlers and the dogs. Reportedly, Nazi SS were trained side by side with a companion German shepherd. At the conclusion of the grueling 12-week course of training, the soldier, to receive his coveted stripes, had to kill his canine comrade by breaking its neck. Presumably, this cruel practice proved that the soldier's allegiance to the Nazi cause was held above his affection and loyalty to his dog (Arluke and Sanders, 1996). Arguably less premeditated and diabolic, but nonetheless following a similar vein of insensitivity, during the abrupt and chaotic evacuation of military forces from Vietnam in 1973, American soldiers were ordered to leave their scout dogs and sentry dogs behind to fend for themselves against an encroaching enemy. These remarkable dogs, who had served nobly and saved many lives, were abandoned as disposable military equipment, with little more official recognition than that given to a jeep or tent peg. Handlers and dogs alike suffered greatly as a result of this inhumane policy.

As noted above, cynopraxic training and counseling take place within a context consisting of a social relationship and a shared home environment. In contrast, the laboratory study of animal behavior is first and foremost the study of *caged* behavior, occur-

ring under the influence of various experimental deprivations and manipulations. In most studies, an animal's relationship with an experimenter is either nonexistent or minimized, and there is rarely little genuine consideration given for the animal subject's quality of life. All *effects of person* and other external influences from the environment are assiduously controlled and excluded as much as possible, so that the specific stimulus-response variables under observation can be measured against an experiential backdrop that is common to all animal subjects. Under the sterile social and environmental conditions of the laboratory, observations are made with little or no reference to an animal's relationship to the experimenter or to the surrounding environment outside of the experimental chamber. These methodological considerations represent cardinal distinctions between the experimental study of dog behavior and cynopraxis. Whereas behavioral scientists experimentally evaluate various hypotheses about how behavior is organized, perhaps hoping to discover fundamental laws in the process, cynopraxists mediate between dogs and owners under the relatively uncontrolled circumstances of a home environment in order to facilitate interactive harmony. Whereas scientists seek "truth" and lawful relations governing animal behavior, cynopraxists strive to attain the simple joys and benefits resulting from the enhancement of the human-dog bond.

A procedural strength of experimental science has been its objective neutrality with respect to its subject matter and findings. In the case of animal studies, the resulting distance between scientists and their animal subjects has often been the target of ethical criticism. When studying inanimate and insentient life, one is not obliged to consider the feelings and distress wrought by one's experimental manipulations. This is not the case, however, when experimenting upon animals, which appear to experience pain and deprivation in a way that is not too dissimilar from our own experience of such things. Consequently, when performing experiments on animals, a researcher's otherwise laudable objectivity runs a risk of attracting the humane critic's scorn and insinuations, suggesting that the scientist's "objective distance" is just a shallow excuse for insensate aloofness and cruelty. This sort of accusatory attack is unfair but does emphasize the need for scientists to perform their research in the most humane ways possible and to consider the welfare of their animal subjects by minimizing the stress and pain to which they are exposed during experimentation. Cynopraxic trainers and counselors recognize the practical value of science but also recognize its inherent ethical and esthetic limitations. Although scientific knowledge is of great importance for effective intervention (insofar as it promotes informed and rational interventions), cynopraxists are bound by empathetic, esthetic, and ethical constraints to apply such knowledge for the actualization of the human-dog relationship and to promote the dog's wellbeing.

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Index

"The most valuable publication about dogs since Scott and Fuller's classic text, *Genetics and the Social Behavior of the Dog*, published in 1965."
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Canine behavioral problems represent a serious welfare concern. Not only are problem dogs at risk of being abused by their frustrated owners, they are also in danger of being euthanized if their difficulties cannot be resolved in a timely manner. Properly addressing such problems requires that the practitioner understand how behavior is biologically organized and influenced by experience. Steve Lindsay's *Handbook of Applied Dog Behavior and Training, Volume One: Adaptation and Learning* provides a comprehensive introduction to the basic applied and scientific literature underlying effective treatment and training programs. The text carefully organizes this information in a technical and scholarly manner that will appeal to the animal behavior specialist, while remaining relevant and accessible to the nonbehaviorist veterinarian, professional dog trainer, breeder, and serious hobbyist interested in dog behavior. Steven R. Lindsay, MA, is a dog behavior consultant and trainer. He provides a variety of professional consulting and training services designed to improve the dog's quality of life. In addition to his long career working with companion dogs, he previously trained highly skilled military working dogs for the U.S. Army. He conducts workshops and is the author of numerous articles on dog behavior and training.

ISBN 0-8138-0754-9
90000
9 780813 807546

Iowa State Press
A Blackwell Publishing Company

Ames, Iowa 50014-8300
www.iowastatepress.com

HANDBOOK OF

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Steven R. Lindsay, MA, is a dog behavior consultant and trainer who lives in Philadelphia, Pennsylvania, where he provides a variety of behavioral training and counseling services. In addition to his long career in working with companion dogs, he previously evaluated and trained highly skilled military working dogs as a member of the U.S. Army Biosensor Research Team (Superdog Program). Mr. Lindsay also conducts workshops and seminars and is the author of numerous publications on dog behavior and training.

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Cover image: "Puppy Carrying a Pheasant Feather," 16th century by Yi Om (Korean). Courtesy of the Philadelphia Museum of Art.

Printed on acid-free paper in the United States of America
First edition, 2001
Volume Two: Etiology and Assessment of Behavior Problems
International Standard Book Number: 0-8138-2868-6

The Library of Congress has catalogued Volume One as follows:

Lindsay, Steven R.
Handbook of applied dog behavior and training/Steven R. Lindsay;
foreword by Victoria Lea Voith.—1st ed.
p. cm
Contents: v. 1. Adaptation and learning.
ISBN 0-8138-0754-9
1. Dogs—Behavior. 2. Dogs—Training. I. Title.

SF433.L56 1999
636.7′0887—dc21

99-052013

The last digit is the print number: 9 8 7 6 5 4

Contents

Preface

In Volume 1, *Adaptation and Learning,* it was argued that the functional epigenesis of behavior takes place under the influence of various environmental and biological constraints, including species-typical tendencies, genetic predispositions, and the alteration of various behavioral thresholds brought about by domestication and selective breeding. Clearly, although extraordinarily flexible and adaptive, dog behavior expresses itself in relatively uniform and consistent ways. The causes of this behavioral regularity are found in both phylogenic and ontogenic influences that continuously act on dogs from their conception to their senescence and death. As the result of selection pressures exerted upon the canine genotype during its evolution or phylogenesis, the dog's behavior has been biologically shaped and prepared to express itself in a limited set of ways. During the dog's development or ontogeny, the environment continues to exert selection pressures on the behavioral phenotype through learning. The dog's behavioral phenotype is the composite of evolutionary mutation and selection (organized in the canine genotype) together with selected refinements and modifications as the result of interaction with the environment and learning. In other words, the dog's behavior is conjointly influenced by both phylogenic and environmental determinants via experience and learning. In addition, the behavioral phenotype at each stage of ontogeny affects subsequent development (prepared and regulated by genes operating on a physiological level) and undergoes further modification by maturational demands and environmental pressures. Finally, it was shown in Volume 1 that successful adaptation and learning depend on the presence of an orderly environment composed of highly predictable and controllable events. Without the presence of a stable and orderly environment, neither natural selection nor selection by learning is possible. Learning is primarily concerned with obtaining predictive information about the environment and refining phenotypic routines and strategies for controlling and exploiting significant events. In the present volume, *Etiology and Assessment of Behavior Problems,* these general theoretical assumptions and principles are applied toward better understanding how adjustment problems develop in dogs. Certainly, whether adaptive or maladaptive, a dog's behavioral adjustment is ever under the dynamic influence of experience and learning operating within the context of biological and environmental constraints. Both learning and biology contribute to a dog's adaptive success or failure.

Borrowing from Tinbergen's terminology, the canine *Merkwelt* or perceptual world significantly differs from the human Merkwelt. As species, we inhabit very different sensory, cognitive, emotional, motivational, and social worlds but still succeed generation upon generation to reach across millions of years of evolutionary divergence to form a profoundly enriching and affectionate bond with one another and to share the same living space cooperatively. Although domestication has helped to bridge the gap, much phylogenic room remains for mutual misunderstanding and interactive tension. Further, as people and dogs live together in closer social arrangements and progressively artificial environments, the likelihood of behavioral tensions and problems is simply bound to increase. In fact, it is nothing short of a biological wonder that we get along together as well as we do. However, not only are we apt to misunderstand one another, dogs are also often exposed to neglect, abuse, detrimental rearing practices, and various other adversarial and environmental pressures, many of which appear capable of disrupting or disorganizing a dog's ability to learn and adjust effectively. Naturally, problems are bound to

occur and do. Every year, thousands of distraught dog owners haul their wayward dogs off to obedience classes or to private animal behavior consultants, seeking advice or training for some puppy or dog behavior problem. Estimates vary, but the vast majority of dogs appear to exhibit at least one undesirable habit that its owner would like to change. Most of these behavior problems are an outcome of inadequate training or socialization and are usually responsive to remedial training and brief counseling. Besides social sources of causation, behavior problems may also develop as the result of chronic mismanagement or neglect of the dog's basic biological needs and requirements for stimulation. Some problems, however, are the result of a more complex etiology, involving cognitive deficiencies, distressing emotional activity, and pervasive behavioral disorganization. Volume 2 is especially concerned with exploring the collective epigenetic causes underlying the development of these more disruptive adjustment problems.

Many behavior problems appear to be strongly influenced by classical and instrumental learning, especially learning strained or disturbed under the adverse influences of stressful anxiety and frustration. Disruptive anxiety and frustration result when a dog's social and physical environment lacks sufficient order and stability in terms of overall predictability and controllability. Social interaction consisting of unpredictable and uncontrollable aversive or attractive exchanges between the owner and the dog is prone to disrupt effective lines of communication, promote stress and distrust, and result in behavioral maladjustment. Other problems appear to stem from trauma and deprivation occurring early in life, resulting in phenotypic disturbances that persist and disrupt the subsequent course of the dog's behavioral development. Finally, some severe behavior problems are under the exacerbating influence of species-typical tendencies and appetites, genetically altered behavioral thresholds, and various physiological and neurobiological sources of causation that may require adjunctive veterinary differential diagnosis and treatment.

A goal of Volume 2 is to examine these and other causes underlying the development of behavior problems. Without accurately identifying and properly assessing the various contributory causes underlying a behavioral adjustment problem, it is not possible to intervene with a truly rational plan of behavior modification and therapy. Despite significant advances in our understanding and treatment of dog behavior problems over the past 20 years, much yet remains to be accomplished in this and related fields of professional activity. Unfortunately, many theories and assumptions in wide public circulation are either dated or unproven. For example, perusing any random selection of dog-care and dog-training books that address dog behavior problems reveals a perplexing and sometimes irritating array of opinions, beliefs, and methods about how such problems ought to be modified or managed. These various texts often espouse conflicting or contradictory information, some encouraging very intrusive or forceful techniques as the necessary prerequisites for controlling undesirable dog behavior, while others admonish the reader to never raise an impatient voice to the errant dog. Much of the contemporary popular literature is confounded by moralistic and ideological agendas that deflect from an honest and rational search for an objective understanding of dog behavior and its effective control and management. Unfortunately, the acceptance of a training system is often based more on an author's personal charisma and fame than on its actual efficacy or scientific merit. The overall result of these influences has been the accumulation of widely divergent and sometimes baffling opinions, theories, and practices performed in the name of companion-dog training and counseling.

An important focus of Volume 2 is to collect and evaluate the relevant applied and scientific literature, with the goal of clarifying what is known about the etiology of dog behavior problems and to highlight what yet remains to be done by way of additional analysis and behavioral research. Although the applied literature is somewhat more consistent and uniform, it also suffers from many of the same maladies found in the popular literature. In spite of an ostensible dedication to the scientific method, many common diagnostic

assumptions and treatment protocols are based largely on anecdotal evidence, isolated impressions, and personal opinions. This state of affairs is compounded by a dearth of confirming evidence that the methods used to treat behavior problems actually function in the ways suggested by the rationales given for their use. Furthermore, notwithstanding the optimistic success rates claimed by some practitioners, no one knows within a reasonable degree of scientific certainty whether the methods work as claimed. The lack of scientific validation is a significant practical and legal concern with respect to the treatment of some potentially dangerous behavior problems such as *dominance* aggression, especially since homologous interspecific models of such aggression remain to be developed and studied under laboratory conditions. Although a few provisional clinical studies have been recently performed to evaluate the efficacy of some behavioral protocols (especially those involving the adjunctive use of drugs), much remains to be done in this important area to place the field of applied dog behavior on a more respectable scientific foundation. In lieu of the needed clinical and laboratory research, it is incumbent upon behavioral practitioners to apply scientifically demonstrated learning and ethological principles for the control and management of dog behavior problems. Most significant progress in the field of applied dog behavior has occurred in the areas of description, classification, and incidence, but even here much confusion remains to be worked out. In addition to challenging conventional wisdom and questioning some widely held (but unproven) assumptions and beliefs, Volume 2 introduces and discusses other ways of understanding dog behavior and adjustment problems in the light of the scientific concepts and principles of ethology and learning covered in Volume 1.

In addition to the various causes discussed above, behavior adjustment problems often reflect an underlying failure of the owner and the dog to connect and bond with each other harmoniously. Such problems may require diligent cynopraxic counseling to resolve. Ultimately, a dog's domestic success depends on the formation of a harmonious and satisfying relationship with human companions and other animals sharing the same home and life experience. Consequently, intervention should always include efforts that simultaneously address social, environmental, and quality of life concerns. At the minimum, a healthy and successful human-dog relationship depends on the establishment of clear lines of communication, interspecies appreciation and understanding, leader-follower cooperation, playfulness, and the lifelong nurturance of mutual affection and trust.

Volume 2 begins with a brief history of applied dog behavior and training. Selecting the content for this chapter was difficult and, admittedly, much of importance has been regretfully omitted for sake of brevity and focus. In general, areas of historical significance for applied dog behavior are emphasized that have been neglected in the past. In Chapter 2, various methods for collecting and assessing behavioral information are introduced, together with a general discussion of etiological factors believed to underlie the development of many behavior problems. The remainder of the text includes reviews, analyses, and criticism of the scientific and applied literature insofar as it is relevant to the etiology, assessment, and treatment of fear, separation anxiety, aggression, behavioral excesses (compulsions and hyperactivity), and appetitive and elimination problems. The volume concludes with a chapter devoted to the cynopraxic counseling process and the role of interactive dynamics and social bonding on the etiology of behavior problems. Although treatment strategies are occasionally discussed, behavior modification and therapy protocols are the subject of a forthcoming text: *Dog Behavior Modification and Therapy: Procedures and Protocols* (Ames: Iowa State University Press, 2001).

Acknowledgments

OVER THE years, I have had the good fortune to benefit from the knowledge of many of the world's most prominent and respected authorities working in the field of applied dog behavior and training. However, special appreciation and recognition are due Drs. Peter Borchelt, Mary Burch, Jaak Panksepp, Barbara Simpson, Victoria Voith, and John Wright for critically reading and commenting on various chapters or portions of the book. Their advice and guidance have been invaluable. Much appreciation is due to Christina Cole for her help in collecting research materials and sundry other forms of assistance that helped keep the loose ends together. The expert editorial guidance of John Flukas has been consistently constructive and sincerely appreciated. I also wish to thank the wonderful staff at Iowa State University Press. I am very grateful for their patience and confidence in the project and deeply appreciative for their care and professionalism.

HANDBOOK OF APPLIED DOG BEHAVIOR AND TRAINING

Volume Two

Etiology and Assessment of Behavior Problems

1

History of Applied Dog Behavior and Training

To his master he flies with alacrity, and submissively lays at his feet all his courage, strength, and talent. A glance of the eye is sufficient; for he understands the smallest indications of the will. He has all the ardour of friendship, and fidelity and constancy in his affections, which man can have. Neither interest nor desire of revenge can corrupt him, and he has no fear but that of displeasing. He is all zeal and obedience. He speedily forgets ill-usage, or only recollects it to make returning attachment the stronger. He licks the hand which causes pain, and subdues his anger by submission. The training of the dog seems to have been the first art invented by man, and the fruit of that art was the conquest and peaceable possession of the earth.

G. L. L. COMTE DE BUFFON, *quoted in* JACKSON (1997)

OUR SPECIES is the only one that keeps and purposefully modifies the behavior of another species to make it a more compatible and cooperative companion and helper. The process of domestication involves at least three interdependent elements: (1) selective breeding for conducive traits, (2) controlled socialization with their keepers, and (3) systematic training to obtain desirable habits. In addition to the effects of selective breeding, socialization, and training, a dog's basic needs are largely provided by a human caregiver. The overall effect of domestication is to perpetuate paedomorphic characteristics into adulthood and to enhance a dog's dependency on its keeper for the satisfaction of its biological and psychological needs, including affection and a sense of belonging to a group. The origins of this process began far back into prehistoric times.

SOCIAL PARALLELISM, DOMESTICATION, AND TRAINING

Close social interaction between early humans and dogs was probably facilitated by the evolution of parallel social structures, especially the tendency to form cooperative hunting groups and extended families. Both

wolves and early humans shared sufficient similarity of social custom to communicate well enough to lay a foundation and bridge for the development of a lasting relationship. One possible scenario is that early humans coming out of Africa approximately 140,000 years ago encountered wolves dispersed throughout the Eurasian land mass. These early humans, perhaps numbering only a few hundred individuals, are believed to have beeen the direct ancestors of contemporary humans. Over a relatively short period, these migrant humans were able to supplant indigenous humans already living in Eurasia. In *Evolving Brains,* John Allman (1999) speculates that the primary advantage needed to achieve this biological precedence and hegemony may have been the domestication of wolves. According to this view, the two species were preadapted to fit each other's ecology and family structure, thus making the transition to domestication relatively easy and natural. By cooperating, the two species may have attained an enormous competitive advantage over other species competing for the same resources. Interestingly, the migration out of Africa by this small group of humans roughly coincides with the first evidence of domestication as indicated by the analysis of mitochondrial DNA sequences. These studies indicate that the domestication of dogs was probably initiated approximately 135,000 years ago (Wayne and Ostrander, 1999). To fully exploit the advantages presented by domestication, early humans must have developed relatively sophisticated means of behavioral control and training. Undoubtedly, our ancestors engaged in activities aimed at limiting some sorts of dog behavior while encouraging other forms as opportunities and needs may have presented themselves. The obvious necessity of training as an integral part of the domestication process prompted Comte de Buffon to conclude that dog training was *the* first art invented by humans (see the introductory epigraph). Whether dog training was the first art will remain the subject of debate; however, one can safely assume that dog training, in one form or another, emerged long before the advent of recorded history.

Cave Art and the Control of Nature

Clearly, early humans were acute observers and sensitive social organizers, living in close-knit and cooperative hunting-gatherer groups. That they were interested in animal habits and their control is attested to by the masterful cave paintings found at Altamira (Spain) and Lascaux (France). These artworks were produced at about the same time that dogs began to appear in the archeological record, between 12,000 to 17,000 years ago (Jansen, 1974). The paintings depict with extraordinary sensitivity and realism a procession of various prey animals (e.g., bison, and deer) captured in line and color and transfixed in time to await rediscovery after many millennia shrouded in darkness. The animals are beautifully rendered in moments of flight or after falling from mortal wounds inflicted on them by the artist-hunter. The purpose of this early art was presumably to exert magical control over the prey animal by capturing its image and "killing" it, thereby giving the hunter success during the chase. One can hardly imagine that the Magdalenian people responsible for cave painting had not also discovered other means of control besides sympathetic magic, just as they had certainly learned how to use many natural forces long before they had names or adequate means to describe them.

Evolution of Altruism and Empathy

The ancient emergence of dog keeping appears to coincide with the evolutionary appearance of altruism and empathy among humans. According to Eccles (1989), the likely foundation of human altruism is the emergence of food sharing, followed closely by the development of the nuclear family and extended family groups. As humans evolved into food-sharing communities composed of individuals cooperating with one another, the emerging tendency toward altruism may have been extended to semidomesticated canids living at the outermost perimeter of their encampments. These early canids also appear to have evolved significant altruistic tendencies and social structures, perhaps sufficient to

attract empathic interest by early humans, if not to mediate symmetrical altruistic reciprocation and exchange. Eccles characterizes *altruistic actions* as purposeful efforts intended to benefit others without regard to how they might benefit oneself. He rejects Dawkins's (1976) more severe definition in which *altruism* denotes actions that benefit another at some expense or sacrifice to the altruistic actor. Eccles appears to assume that the advent of human altruism entailed an awareness of self and empathy for others. As a result of such evolutionary elaborations and social developments, altruistic humans may have been prompted to feel sympathy and pity for dogs living and suffering in their midst, thereby facilitating a growing sense of commonality and responsibility toward dogs.

Early training activities probably included the contingent sharing of food based on dogs behaving in some particular way (e.g., begging). The power of empathy would have offered early humans the ability to consider how their actions might influence dogs. In fact, the development of human empathy and its extension to dogs provides a viable means for understanding how the evolutionary gap between our two species was narrowed sufficiently to enable close interspecies cohabitation and domestication. Human altruism, coupled with empathy for others (especially those belonging to a common group that are acted toward altruistically), may have provided the foundation for the dog's domestication and behavioral incorporation. Human altruism and empathy seem to be especially strong toward the young, perhaps explaining the evolutionary trend toward paedomorphosis in dogs (see *Paedomorphosis* in Volume 1, Chapter 1). Paedomorphic dog types may have enjoyed a significant survival advantage by evoking altruistic caregiving and protective behavior in human captors.

Dogs and the Ancient World

The earliest historical records of dogs come mainly from the art of Egypt and Assyria (Merlin, 1971). Archeological findings suggest that at least a dozen different breeds existed in ancient Egypt, ranging from the greyhound-like coursing hound and mastifflike hunting dogs to dogs resembling the modern dachshund. Egyptian hunters primarily used coursing hounds that were slipped to chase down fleeing game. Egyptian breeders selected for traits and structural attributes conducive to this sort of hunting activity, as well as short-legged dogs, perhaps, used for digging into burrows after fleeing animals (Figure 1.1). As such, all breeding is a form of antecedent control over behavior that is subsequently refined and brought into practical expression by the agency of training. As remains common today, the breeding and training of dogs were probably overseen by the same person.

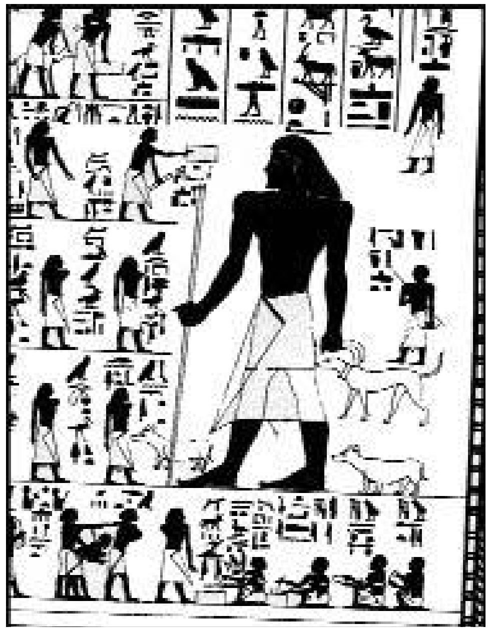

FIG. 1.1 Egyptian hunters developed a variety of breeds for different tasks, ranging from the sleek coursing hounds to short-legged dogs that may have been used for chasing prey to earth. (Detail from an Egyptian tomb painting, Beni Hasan, 1900 B.C.)

By the time Herodotus visited Egypt in the mid-5th century B.C., the dog was found living in homes as companions. When house dogs and cats died, the household experienced a period of mourning. The dead animals were mummified and given ritual burials. Other evidence of highly developed breeding and

FIG. 1.2 Large mastiff-type dogs were used by Assyrian hunters to hunt large prey. Note the early use of slip collars. Assyrian dogs also wore bronze collars shaped in the form of a spiralling ring (Assyrian bas-relief, 7th-century BC).

training practices comes from Assyrian bas-relief depictions of powerful mastiffs used for various hunting purposes (Figure 1.2). Unfortunately, details from this period are lacking with respect to the methods of training used, but there can be little doubt that training played an important role in the way such dogs were prepared for the hunt and to live in close contact and harmony with humans.

As suggested by Homer's verses describing the sorrow felt by Odysseus for his dying dog Argos ("Swift"), Greek dogs were held as objects of sincere affection and symbols of devotion and faithfulness (see *Dog Devotion and Faithfulness* in Volume 1, Chapter 10). However, the Greek attitude toward dogs was complex, with many common expressions of contempt and personal insult involving reference to dogs. By the 5th century B.C., various dog breeds had been developed for specific hunting tasks and other purposes, such as guarding and shepherding flocks. In addition to working dogs, the Greeks also kept household or "table" dogs and small Melitean lapdogs as pets (Halliday, 1922). The breeding and training of hunting dogs appear to have been significant pastimes for ancient Greeks. Xenophon (circa 380 B.C.), a student of Socrates, wrote a valuable tract on dog husbandry and training entitled *Cynegeticus* (Hull, 1964; Merchant, 1984; see Xenophon, 1925/1984a), which gives the reader a rare glimpse into the breeding and management of Greek hunting dogs. For hunting hare, Xenophon recommends the Castorian and vulpine breeds, the latter of which was believed to be the result of an admixture of dog and fox lineage—a false belief that was widely accepted at the time. Aristotle perpetuated the vulpine-cross belief in his *History of Animals* and further suggested that the Indian hound (a particularly aggressive variety) was the result of crossing a male tiger with a female dog. These Indian hounds (mastiff-type dogs) were used for deer hunting and other pursuits that required bigger and stronger breeds. For wild boar, a variety of dogs were employed in a mixed pack, including the Indian, Cretan, Locrian, and Laconian breeds. Apparently, great care was taken to keep these breeds unadulterated. Control over undesirable matings was discouraged by the use of a spiked *surcingle,* or girth strap, that was wrapped around the female dog's body (Hull, 1964). However, Merlin (1971) has suggested that another possible function of this piece of equipment was to protect the dog from injury when hunting dangerous game like wild boar.

Xenophon recognized the value of early training and recommended that a dog's education be started while it was still young and most eager to learn. During the early stages of

training, hare-hunting dogs were trained to drive fleeing prey into snag nets by feeding the dogs near the location of the nets, at least until they developed a sufficient appetite for the hunt itself to perform the task of coming to the nets without such aid. Young trailing dogs were placed on long leashes and paired up with more experienced dogs to hunt hare. As their training progressed, novice dogs were restrained until the hare was out of sight and then released to ensure that they relied on scent rather than sight to follow and locate the fleeing prey. If a puppy failed to trail an animal in the correct direction, the puppy was recalled and the procedure repeated until the behavior was mastered (Hull, 1964).

Xenophon (1925/1984b) also anticipates with surprising accuracy a number of modern training theories and techniques. Although Thorndike has been credited with the discovery of the *law of effect,* stating that behavior is strengthened (stamped in) by reward and weakened (stamped out) by punishment (see *Basic Mechanisms of Behavioral Change: Stamping In and Stamping Out* in Volume 1, Chapter 7), Xenophon enunciated this basic rule of animal training well over 2000 years ago in his essay *On the Art of Horsemanship:*

> Now, whereas the gods have given to men the power of instructing one another in their duty by word of mouth, it is obvious that you can teach a horse nothing by word of mouth. If, however, you reward him when he behaves as you wish, and punish him when he is disobedient, he will best learn to do his duty. This rule can be stated in few words, but it applies to the whole art of horsemanship. (341)

It is easy to recognize how closely this dictum anticipates Thorndike's formulation. In addition to possessing a clear understanding of the value of behavioral consequences for the control of behavior, Xenophon also appreciated the usefulness of presenting rewards and punishers in a timely manner, stressing the importance of a close temporal connection between the action to be influenced and the consequences used to achieve that effect:

> He [the horse] will receive the bit, for example, more willingly if something good happens to him as soon as he takes it. (341)

He then continues:

> He will also leap over and jump out of anything, and perform all his actions duly if he can expect a rest as soon as he has done what is required of him. (341)

This latter passage describes a practice anticipating the *Premack Principle,* which states "for any pair of responses, the independently more probable one will reinforce the less probable one" (Premack, 1962:255). In addition to appreciating the usefulness of reward training, Xenophon was also fully aware of the methods for establishing escape, avoidance behavior, successive approximation, fading, and stimulus control:

> When a man has a raw horse quite ignorant of leaping, he must get over the ditch himself first, holding him loosely by the leading-rein, and then give him a pull with the rein to make him leap over. If he refuses, let someone strike him as hard as he can with a whip or a stick: whereupon he will leap, and not only the necessary distance, but much further than was required. In future there will be no need to beat him, for if he merely sees a man approaching behind him, he will leap. As soon as he has grown accustomed to leap in this way, let him be mounted and tried first at narrow, and then at wider ditches. Just as he is on the point of springing touch him with the spur. (337)

This list of parallels between ancient training methods and modern learning theory could go on to include many other examples demonstrating the existence of a sophisticated understanding of training methodology already current during Xenophon's time and probably in existence long before. In addition, Xenophon was aware of the value of such modern techniques as direct exposure (habituation), counterconditioning, and modeling for modifying fears. All of these methods are implied in the following passages:

> One should also handle those parts in which the horse likes most to be cherished, that is to say the hairiest parts and those where the horse has least power of helping himself, if anything worries him. Let the groom be under orders also to lead him through crowds, and accustom him to all sorts of sights and all sorts of noises. If the colt shies at any of them, he must teach

> him, by quieting him and without impatience, that there is nothing to be afraid of. (307, 309)

A few pages later, he continues on the subject of fear and its management:

> The one best rule and practice in dealing with a horse is never to approach him in anger; for anger is a reckless thing, so that it often makes a man do what he must regret. Moreover, when the horse is shy of anything and will not come near it, you should teach him that there is nothing to be afraid of, either with the help of a plucky horse—which is the surest way—or else by touching the object that looks alarming yourself, and gently leading the horse up to it. To force him with blows only increases his terror; for when horses feel pain in such a predicament; they think that this too is caused by the thing at which they shy. (325, 327)

Animal training has been operating at a fairly sophisticated level over the ensuing centuries since the appearance of Xenophon's *Cynegeticus* in the 4th century B.C. Like the Greeks, the Romans also appear to have been well versed in the art of dog training. In addition to companionship, several practical uses were made of dogs, such as hunting, pulling carts and chariots, guarding, and military work (Figure 1.3). Dogs were trained to perform in Roman circuses and on the stage. During one of these performances, a dog reportedly walked on two feet, danced, and feigned death after eating a bit of "poisoned" food (Griffith, 1952; Riddle, 1987). Immediately upon taking the food, the dissimulating dog appeared to become sick, thereupon staggering about the stage, until at last it fell down and remained perfectly still on the floor, as though dead. Actors then proceeded to grab and abuse the "corpse," dragging the dog around the stage, thereby making the illusion even more convincing. Throughout the performance, the dog remained motionless. At last, the trainer signaled the dog to break the trance, and it suddenly jumped up and rushed affectionately toward the trainer as the crowd looked on with amazed delight at the training feat.

Although Romans often lived in close association with dogs as domestic protectors and companions, affectionate care and treatment of pet animals were looked upon with some degree of official contempt by Roman leaders.

FIG. 1.3 The Romans used guard dogs to watch over their homes. This ancient warning inscribed is *Cave Canem,* "Beware of the Dog" (Pompeii mosaic).

Plutarch, for example, recorded an anecdote revealing Caesar's apparent disdain for the public display of such affection for pet animals, suggesting that such behavior was neither accepted nor considered natural by the Roman elite:

> On seeing certain wealthy foreigners in Rome carrying puppies and young monkeys about in their bosoms and fondling them, Caesar asked, we are told, if the women in their country did not bear children, thus in right princely fashion rebuking those who squander on animals that proneness to love and loving affection which is ours by nature, and which is due only to our fellow-men. (Plutarch, 1914: Pericles 1.1)

In China, merchants made use of messenger dogs to communicate over long distances (Humprey and Warner, 1934). These canine messengers carried valuable advance information about cargo and progress from camel caravans approaching remote population centers. In addition to shepherds and guards, the presence of such messenger dogs 1000 years ago in China makes it certain that a fairly sophisticated level of understanding about dog behavior and training was widely dispersed throughout the ancient world. Over the centuries, animal training has provided the means to conform the dog's behavior to utilitarian purposes and the amusement of crowds (Figure 1.4).

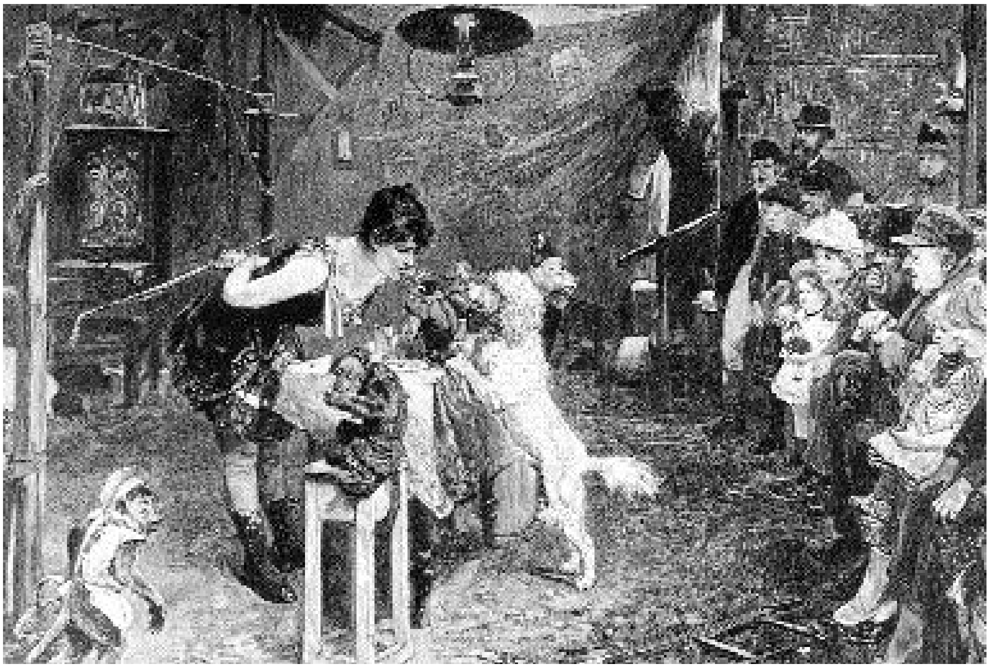

FIG. 1.4 A 19th-century German animal trainer performing with monkeys and a poodle. (Detail from *Ein Bravourstück,* an etching by Paul Meyerheim.)

ROOTS OF MODERN TRAINING

From the earliest times onward, countless conflicts between the dog's behavior and our expectations of it have tested and tempered our relationship. Even today—as any dog owner will testify—a dog's adjustment to family life rarely occurs without some tension and conflict. Little is known about how problem dogs were handled in the ancient past, but the methods employed were probably not much different from those used at the time to educate and discipline children. Corporal punishment certainly played an important role, with whipping being a very popular form of punishment until very recent times (Blaine, 1858; Hammond, 1894).

Although whipping was widely accepted and used to control unwanted dog behavior, it would be unfair to paint the picture of historical dog training with an overly broad brush. For example, H. W. Horlock (1852), a leading authority on the subject, wrote at length in his *Letters on the Management of Hounds* praising the virtues of reward and gentle training methods. Horlock clearly recognized the incendiary effect of corporal punishment on aggression, describing several cases in which whipping resulted in attacks against the "whipper-in." In one of his letters, he described a telling incident involving a highly aggressive hound that he attempted to punish for fighting:

> There was one [hound] particularly cross and savage with the other hounds, and, catching him one day fighting and quarrelling, I called the other hounds out of the kennel, and resolved to make him know better. I laid the whip upon him sharply; but, at every cut I gave him, he jumped at me, with his bristles up, as savage as a lion. Seeing I might kill but could not subdue him, I threw the whip down on the floor, and, holding out my hand, called him to me by name. He immediately approached, with his bristles and stern well up still, and licked the hand held out to him. The lesson was never forgotten by me. (211)

Following this insight, Horlock goes on to describe a rather contemporary-sounding

management strategy for controlling disruptive and injurious fighting that was occurring in his kennels nightly:

> I adopted afterwards the plan of separating at night the most quarrelsome, but in the summer it was difficult to keep them from fighting without constant and long exercise. More, however, was done by the voice than the whip, which I found only made them more irritable. With kind words they would do anything, and, as I always made pets of them, their tractability was shown in various ways. (211–212)

Horlock also emphasized the use of rewards for establishing control, describing the following steps for training the dog to come to its name:

> First give them names, and make them understand them. If you can find time to feed them yourself, do so, calling them by name to their food; if not take them out walking with you every day for an hour or two; put some hard biscuits in your pocket, give the dog a few bits at starting [establishing operation], call him by name occasionally when running forward, and every time he returns to you when called, give him a piece of biscuit; pat him and caress him the while. Follow this lesson for a week or ten days, and the dog will soon begin not only to know but to love his master. (223)

His emphasis on kindness and *connecting* with the dog for promoting cooperative behavior is further underscored by the following insightful passage:

> There are some persons to whom dogs become more readily attached than to others. The eye and the voice are a terror to some, as they are also an attraction to other animals. A soft eye, beaming with gentleness and good temper, is a point to which the instinct of the canine race naturally directs them, nor are they often deceived in its expression. Kind and benevolent looks have as great an influence over the animal as they have over the human species. They are, moreover, a sure criterion of temper. (223)

European Influences

Konrad Most is considered by many authorities to be the "father of modern dog training." As a captain in the German army, he was responsible for the formation of the German military-dog service during World War I, and from 1919 to 1937 he served as the director of the Canine Research Department of the Army High Command. Originally published in 1910, his book *Training Dogs* (1955, English) anticipates the articulation of many behavioral concepts and principles (e.g., shaping, primary and secondary reinforcement, stimulus control, punishment, and extinction) subsequently developed and refined by experimental analysis (Burch and Pickel, 1990). Although Most's work had its greatest influence in Europe, many American trainers have also benefited from his insights. Despite being dated and containing some problematic content, *Training Dogs* remains a "must read" for professional trainers and a useful resource for those interested in the history of dog training.

The reports of heroic dogs used during World War I led to heightened public interest in dog training, with high demand for dogs capable of performing specialized tasks such as police work and guiding the blind. The first official police dogs were reportedly trained and deployed in 1886 by Captain Schoenherr to control criminal activity in Hildesheim, Germany (Humphrey and Warner, 1934), although some evidence suggests that police-type dogs had been trained for police work long beforehand. Systematic efforts to train "police" dogs appears to have been already under way by the 15th century and probably much earlier. A description of such training appears in the writings of Heinrich Mynsinger published in 1473 (Von Stephanitz, 1925). These early police dogs were trained to stand ground against a human agitator (protected by a cloak of heavy hides) and to "track out the thief and the knave" (Figure 1.5). The brutal deployment of dogs by the Spaniards during the conquest of the Caribbean reveals that the Spanish already had a fairly advanced understanding of such matters by the 15th century (Varner and Varner, 1983).

By 1903 in Germany, various tests and efficiency trials were developed for evaluating police service dogs (Von Stephanitz, 1925) and, by 1914, as many as 6000 dogs were ready for military use (Griffith, 1952), with approximately 28,000 being requisitioned during World War I by the German

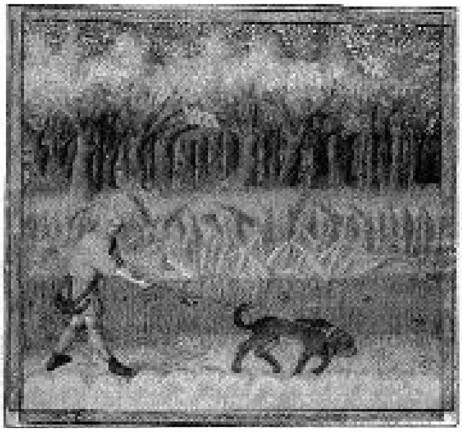

FIG. 1.5 A 15th-century tracker using a hound to trail a thief. (From *Treatise on Hunting* by Gaston Phébus. Bibliothèque Nationale, Paris.)

army (Von Stephanitz, 1925). Such police dogs gradually became a prominent feature of law enforcement in Europe. In England, Col. E. H. Richardson (1910) promoted the use of military rescue and ambulance dogs at around this date, and in 1916 established the War Dog Training School. Guide dogs appeared in Germany in 1917, primarily trained to assist soldiers blinded during the war, but strong evidence suggests that guide dogs were trained and used by the blind long before this date (Coon, 1959). In 1927, Dorothy Harrison Eustis, a Philadelphian living in Switzerland, enthusiastically described the training of guide dogs taking place at the Potsdam School for the Blind. The article, printed in the October 1927 issue of the *Saturday Evening Post,* caught the attention of a blind man, Morris Frank, who wrote a letter to Eustis expressing his appreciation and desire to come to Fortunate Fields (see below) to receive a guide dog of his own. Eustis agreed and, by 1928, Frank was back in America with a female German Shepherd guide dog named Buddy. Frank and Buddy rapidly became a media sensation and, in 1929, together with the financial support of Eustis, The Seeing Eye was founded in Morristown, New Jersey, where it has operated continuously up to the present. Canine guides for the blind were such a success that by the early 1930s several thousand guide dogs were already in use throughout Europe and the United States (Humphrey and Warner, 1934).

At about this time, several trainers schooled in German training techniques came to the United States to establish various dog-training schools. Especially prominent in this regard was Carl Spitz (1938), Hans Tossutti (1942), and Joseph Weber (1939). Spitz, who had been trained as a military-police dog handler in Germany, immigrated to Chicago in 1926. After 2 years in Chicago, he relocated to Southern California, where he established a training kennel. Although most famous for his work with dog actors (e.g., Buck, in *The Call of the Wild* with Clark Gable), Spitz strongly emphasized the importance of training for family pets, specifically, for the improvement of a dog's character and adaptation to life with humans: "Only a well-behaved dog can possibly be 'man's best friend'" (101). On the East Coast, Weber, an experienced German trainer who had been schooled at the Berlin Police School and Potsdam School for the Blind, established a dog-training school in Princeton and made significant contributions to the development of competitive obedience training (see below). Like Weber, Tossutti was associated with the Potsdam School for the Blind and the Berlin Police School, where he was an instructor. Tossutti established a successful dog-training school in Boston.

Famous Dogs

Enthusiastic public interest in dog training was propelled by the sensational appearance of highly trained, intelligent, and well-behaved canine actors like Fellow, Rin-Tin-Tin, and Strongheart. The appearance of these dogs in motion pictures set the stage for a growing awareness of dogs' capabilities to learn. For example, Fellow, a German shepherd dog, was reputed to respond to 400 vocal commands and perform a variety of complex sequences of behavior (see *Nora, Roger, and Fellow: Extraordinary Dogs* in Volume 1, Chapter 4). His fame caught the attention of two prominent psychologists at Columbia University, who subsequently verified many of the dog's unusual abilities by testing them under stringent laboratory conditions (Warden and

FIG. 1.6 The *Science-Newsletter* (now *Science News*) of July 14, 1928, featured a photo of Fellow on its cover, reporting that C. J. Warden, together with J. B. Watson, had set up a "Fellow Fund" in hopes of raising $100,000 in public donations to support continued dog behavior research at Columbia Univeresity.

FIG. 1.7 Strongheart exerted a tremendous fascination on the public, both as the result of his film work and the inspired literary efforts of J. Allen Boone. (Trimble-Murphin Productions, 1924.)

Warden, 1928) (Figure 1.6). The trainer-owner (J. Herbert) attributed his success with Fellow to a habit of talking to the dog "constantly almost from birth." The trainer also stressed the importance of avoiding corporal punishment.

The original Rin-Tin-Tin (named after a good-luck doll given to soldiers by French girls) was one of five puppies found by Lee Duncan that had been abandoned with their mother in a shelled German bunker in 1918 at Metz, France (Duncan, 1958). Rinty made his first film debut in *The Man from Hell's River* in 1922. Until his death in 1932, the canine film star made a total of 24 movies for Warner Brothers, followed by numerous other movie and television appearances by a long line of Rin-Tin-Tin descendants. Rinty's sensational success on the screen was certainly influenced by a craze sparked earlier by another famous German shepherd dog actor named Strongheart, whose film debut occurred 7 months earlier in *The Silent Call.* Strongheart was a highly trained police dog obtained when he was 3 years old from an impoverished German breeder at the end of World War I (Trimble, 1926). Strongheart (aka Etzel von Oeringen) made a dramatic impression on silent-film enthusiasts, rapidly acquiring international fame for his sagacity and physical prowess on the silver screen (Figure 1.7). Strongheart's lasting fame, however, comes primarily from the profound effect he had on J. Allen Boone, a Hollywood publicity writer, whose life was indelibly changed by the dog's companionship (see *Mysticism* in Volume 1, Chapter 10). Boone carefully recorded how this unique relationship transformed his life in *Letters to Strongheart* and *Kinship with All Life.* Together, Fellow, Rin-Tin-Tin, and Strongheart raised the public image of dogs to a new level of respect and appreciation, while underscoring the value of training for actualizing a dog's potential.

American Field Training

Until the 1930s, dog training in the United States had its largest following of enthusiasts among hunters. Among trainers of field dogs, Hammond (1894), Lytle (1927), and Whitford (1928) stand out as prominent and well-respected authorities. Although writing primarily for hunters, they provided their readership with many tips and methods for general obedience training and problem solving. Carlton (1915), writing at this time on the subject of hunting dogs, made an early effort to bridge the gap between science and the practice of dog training:

> Few breakers are aware that the dog's mind, in common with that of other animals, has been scientifically studied and that many patient observations and careful experiments are recorded in an extensive literature on the subject of "Animal Psychology." It is remarkable that the accepted principles of dog-breaking—which in most cases have been arrived at empirically and handed down by tradition—are to a great extent in accord with the scientist. This chapter is a first attempt to interest breakers in the subject. . .. Although the scientist abhors mere anecdote, he is at the same time conscious of the great disadvantages accompanying test conditions, and recognizes the value of observations and suggestions of the breaker when founded on a careful record of fact. (173–175)

Carlton goes on to interpret and summarize Thorndike's various laws and rules of learning in terms relevant to efficient dog training (see *Thorndike's Basic Laws* in Volume 1, Chapter 7):

1. The association in the dog's mind of satisfaction with the response we desire to encourage, and discomfort with the response we desire to inhibit.
2. The amount of satisfaction or discomfort.
3. The closeness in point of time and the preciseness of the connection between the response and the satisfaction or discomfort.
4. The frequency with which the response we desire is connected with the given situation and the duration of each such connection.
5. The readiness of the response to be connected with the situation.
6. The fact that to your dog a "situation" is at first a complex matter consisting of many elements in addition to the one element to which you are teaching him to give the desired response.
7. It is easier to obtain the response you desire de novo, than to get rid of a response already established and form a new one (184–185).

Books also began to appear during this period that were expressly written for average dog owners. For example, Lemmon (1914) published an interesting little book for dog owners detailing the various benefits of dog training and other germane topics, ranging from parlor tricks to the proper care and selection of a family dog.

An early and enthusiastic dog-training authority and editor of *Dog World Magazine,* Will Judy (1927), published a book sold under the same title as Lemmon's tract, viz., *Training the Dog.* Judy's very popular version contains numerous illustrations, training tips, and ways to control common behavior problems. Although such books occasionally contain valuable insights, most of the information is passé in comparison to contemporary standards. Nonetheless, this popular dog-training literature provides a valuable cultural and historical backdrop for studying and appreciating subsequent progress in the field.

Organized Competitive Obedience

The appearance of organized obedience training and the sanctioning of competitive trials by the American Kennel Club (AKC) slowly took form during the late 1930s. The person most often attributed with the distinction of bringing obedience competition to America from Europe is Helene Whitehouse-Walker. An avid poodle breeder and exhibitor, Walker discovered that in England the poodle and the German shepherd excelled in competitive obedience work. During an extended stay in England, she studied the various methods in use and subsequently introduced the sport of competitive obedience to the American dog fancy. She was an untiring advocate for the recognition of obedience training as a dog sport. The first American obedience trial took place in 1933 at Mt. Cisco, New York (Burch and Bailey, 1999). Walker petitioned the AKC

for recognition of obedience trials early in the 1930s, with full sanctioning and legitimacy being granted by the AKC in 1936. In collaboration with her assistant, Blanche Saunders (1946), and with Josef Weber, they established the official rules and obedience tests used by the AKC to judge obedience proficiency and to grant appropriate awards. In 1940, Walker and Saunders, traveling across the country in a house trailer, promoted the benefits of dog training and performed numerous obedience demonstrations. By 1941, many obedience clubs had already been organized and had started to offer public obedience classes to meet a growing interest in the new sport.

Dogs and Defense

As it turns out, this series of events was a stroke of good fortune for a country about to go to war. The pioneering efforts of Walker and Saunders provided a ready resource for a volunteer organization that would soon form to procure dogs for the war effort. Dogs for Defense (DFD) was spearheaded by Alene Erlanger, a prominent breeder and fancier, along with numerous other breeders, handlers, and trainers committed to the use of dogs for national defense. The AKC played a prominent facilitatory role in the organization and success of the DFD, which was officially launched in January 1942 and continued to serve a procurement function until March 1945. The activities of the DFD were coordinated by the Quartermaster General's Office. Interestingly, Mrs. Erlanger, a dog fancier, breeder, trainer, and judge, wrote the first major dog-training manual for the army (TM 10-396-War Dogs), as well as numerous technical bulletins and training films (Waller, 1958).

War Dogs

Prior to this time, the U.S. military had made little use of dogs (primarily sled dogs), and the DFD rapidly became the official source of dogs for military use. Although originally charged with the procurement and training of sentry dogs, the civilian instructors proved ill-prepared to train military working dogs and handlers. The responsibility for the procurement and training of sentry-dog teams was transferred to the Remount Branch in the summer of 1942. The DFD was delegated procurement responsibilities by the Remount Branch, setting up several procurement centers across the country for receiving dogs. The Quartermaster General established various training centers, including Front Royal Quartermaster Remount Depot (Virginia), Camp Rimini (Montana), Fort Robinson (Nebraska), San Carlos (California), and Cat Island (Mississippi). From 1942 to 1944, the DFD recruited 40,000 dogs. Of these, 18,000 were distributed among the various training centers. Approximately 8000 were returned to their owners as the result of some physical or temperament shortcoming detected during initial evaluations. Ultimately, some 10,000 dogs were mobilized and trained for military service during World War II. These dogs were trained to perform five primary duties: sentry, sled and pack, messenger, mine detection, and scouting. Dogs provided outstanding service in the war effort, with at least one having been awarded a Silver Star and Purple Heart for heroism—commendations that were subsequently revoked because of an army policy against the issuance of such awards to animals. Approximately 3000 dogs were *demilitarized* at the conclusion of World War II and returned to civilian life as heroes, with very few complaints regarding their behavior upon discharge from service (Waller, 1958).

After the War

At the end of the war, many handlers and trainers (civilian and enlisted) left the military to pursue civilian dog-training careers. One of these civilian trainers was William Koehler. Despite Koehler's fame (known mostly for his work at Walt Disney Studios), credentials, and achievements, no dog trainer inspires quite as much heated controversy as he does. Proponents and ardent apologists [most notably Hearne (1982)] defend his training methods with an almost irrational fervor, whereas detractors vigorously condemn them as being excessively brutal and cruel. In response to his critics, he appeared to be comforted by an apparent haughty self-estimation and an unbridled contempt for their evident

lack of appreciation and understanding, exclaiming "I guess the nicest thing that could happen to you is to enjoy the enmity of the incompetent" [quoted in Lenehan (1986:43)]. Koehler had little tolerance for these "cookie people" and "humaniacs" (terms he was pleased to use when referring to his critics), whose gentle approach he eschewed as "nagging a dog into neurosis." Although many of Koehler's problem-solving methods (hanging, beating, and other abusive practices) have been repudiated, many active dog trainers still use his methods for obedience training, usually in a modified form.

As the popularity of dog training caught on during the 1950s and 1960s, many capable and humane dog trainers appeared on the scene. Of particular note in this regard are Winifred Strickland (1965) and Milo Pearsall (Pearsall and Leedham, 1958), both highly influential and successful competitive obedience trainers. In 1965, Pearsall, together with Earl Traxler, founded the National Association of Dog Obedience Instructors (NADOI) in Manassas, Virginia (Tardif, personal communication, 2000). An important goal of the organization was to encourage greater uniformity in group dog obedience instruction and to disseminate relevant information to foster that end. Pearsall emphasized the need to train dogs from a canine point of view, thereby making training more humane and easy for dogs to understand. In addition, Pearsall is remembered for pioneering puppy group classes or "kindergarten puppy training" (K.P.T.) and stressing the use of guided *play* rather than more adversarial training techniques. NADOI members are primarily group instructors training dogs in close adherence to AKC obedience regulations, often doing so in preparation for AKC-sanctioned obedience competition. Many others deserve mention, but, unfortunately, space severely limits this discussion, and the subject will need to be left for another time. One trainer active during this time, however, deserves special mention for her contributions to modern dog training and dog behavior counseling. Ramona Albert (1953) developed several key advances in our understanding of dog behavior (and misbehavior). She strove in her practice to connect with dogs on a motivational level, but avoided the moralistic and emotionally charged anthropomorphic interpretations of a dog's intentions, a pitfall that snared so many trainers of her time. In addition, she strongly emphasized the importance of *listening* to a dog's behavior as a form of subtle communication revealing its inner state. Finally, she encouraged dog owners to exercise patience and intelligence and advised them to use relatively gentle methods for gaining control. Many of her techniques anticipate more contemporary approaches in vogue today for the management of severe behavior problems, especially her approach to the treatment of aggression and separation-related problems. She appears to be the first trainer-counselor to articulate a distress-anxiety theory of destructive behavior occurring in the owner's absence.

Vietnam and Dog Training

An important influence on training theory and method occurred somewhat surreptitiously as the result of various military studies and dog-training projects contracted by the U.S. Army during the 1960s and early 1970s. Prompted by the Vietnam War, the government poured millions of dollars into basic research and development of various military-dog programs. In addition to selective breeding programs (e.g., the Biosensor Research Team or "Super Dog" Program under the command of Col. M. W. Castleberry), many behavioral studies were performed focusing on complex training objectives and a dog's ability to execute them. Contracted by the Army, Roger W. McIntire (1968) directed the Canine Behavior Laboratory at the University of Maryland, where he performed numerous studies investigating the suitability of dogs for military service. Other research activities were centralized at the U.S. Army Land Warfare Laboratory in Aberdeen, Maryland. Research objectives included the feasibility of employing remote-controlled scout dogs (Romba, 1974), mine and tunnel dogs (Breland and Bailey, 1971), multipurpose dogs (Dean, 1972a), and explosive and narcotic detection (Romba, 1971; Dean, 1972b). Most of these studies were performed by civilian behavioral psychologists in close cooperation with military-dog handlers. Naturally, this meant that many dog

handlers were exposed to various classical and instrumental conditioning procedures used to modify dog behavior. Upon leaving the military, many of these handlers pursued civilian careers, applying this new knowledge of behavioral control to their public dog-training programs. [For an excellent summary of the important services performed by military working dogs in Vietnam, the reader should consult Michael Lemish's *War Dogs: Canines in Combat* (1996)].

THE MONKS OF NEW SKETE

Although many traditional dog trainers have emphasized the importance of training for attaining a satisfying relationship with dogs, the Monks of New Skete (1978, 1991) introduced a unique existential or spiritual significance and appreciation of dogs and training. For the most part, the Monks accommodated conventional dog-training methods and refined them but have also made some significant innovations of their own. An especially valuable contribution was the emphasis they placed on the human-dog relationship as something possessing value in its own right. Traditionally, *how to* books often gave considerable space to practical applications of training, such as competitive obedience and protection training, but neglected to emphasize the relationship-enhancing aspects of obedience training. The Monks specifically stress the value of training as a means for building a relationship through enhanced communication and cooperation. Ultimately, the training process is viewed as a means to intensify one's sensitivity and awareness of the self, the dog, and nature. The essence of this philosophy of training is poignantly expressed by the founder of the New Skete breeding and training project, Brother Thomas Bobush, who wrote,

> Learning the value of silence is learning to listen to, instead of screaming at, reality: opening your mind enough to find what the end of someone else's sentence sounds like, or listening to a dog until you discover what is needed instead of imposing yourself in the name of training. (1978:xiii)

In terms of technical innovations, the incorporation of massage and relaxation techniques into the training and socialization process was, perhaps, the Monks most lasting contribution to modern dog training.

NEW YORK AND THE NORTH AMERICAN SOCIETY OF DOG TRAINERS

In 1972, a youthful Job Michael Evans entered the cloistered environs of the New Skete monastery to became a monk and apprentice dog trainer under the tutelage of Brother Thomas. During the next 11 years, he helped to guide the monastery's breeding and training program and cowrote the highly successful "How to Be Your Dogs Best Friend" (1978). He left the monastery in 1983 and shortly thereafter established a dog-training and counseling service in New York City. Evans rapidly became a highly influential author, professional dog trainer, and speaker. He is credited with authoring the first books written expressly for the instruction of private dog trainers (1985, 1995). Together with other prominent New York dog trainers, he helped to found the Society of North American Dog Trainers (SNADT) in 1987. Charter members included several highly regarded trainers, such as Carol Benjamin, Arthur Haggerty, and Brian Kilcommons. The organization soon established a respected multilevel certification process and a code of ethics. SNADT promoted a positive public image of the dog-training profession and its value for society: "SNADT believes that dog training is an essential service for a humane and rational society that cherishes dogs in the human environment. Dog training is an honorable profession worthy of public respect and esteem" (Evans, 1995:47). SNADT operated out of the American Society for the Prevention of Cruelty to Animals (ASPCA) for several years, until it was brought to an untimely end in 1995.

SCIENCE AND BEHAVIOR

Mountjoy and Lewandowski (1984) have noted that most of the basic concepts and principles of modern behavior modification (e.g., shaping, chaining, positive and negative reinforcement, time-out, stimulus fading, and

response prevention) were in steady use long before they were named and systematically studied in the laboratory. By way of illustrating these observations, they describe an animal act [performed in 1799 and reported by J. Strutt (1876)] consisting of a dozen little birds carrying toy muskets and wearing paper caps on their heads. A soldier bird marched a "deserter" bird up to a toy canon, when

> Another bird was immediately produced, and a lighted match being put into one of his claws, he hopped boldly on the other [to]. . . the cannon, and applying the match to the priming, discharged the piece without the least appearance of fear or agitation. The moment the explosion took place, the deserter fell down, and lay apparently motionless, like a dead bird but at the command of his tutor he rose again; and the cages being brought, the feathered soldiers were stripped of their ornaments, and returned into them in perfect order. (1801/1876:341)

The complexity and sequential order of this performance clearly suggest that the bird trainer was intimately familiar with many of the basic principles of learning (including systematic desensitization) and various sophisticated behavior-organizing procedures (such as shaping and chaining). It was not until animal behavior became the subject of experimental study that the familiar scientific terms would be applied to these practical techniques and procedures.

A pronounced influence on the study of dog behavior and psychology was the publication of the seminal research of the Russian physiologist Ivan Pavlov and his coworkers (1927/1960). Credited with the discovery of classical conditioning (see *Classical Conditioning* in Volume 1, Chapter 6), Pavlov clearly recognized the significance of animal training for a science of behavior:

> It is evident that many striking instances of animal training belong to the same category as some of our phenomena, and they have borne witness for a long time to a constant lawfulness in some of the psychical manifestations in animals. It is to be regretted that science has so long overlooked these facts. (1928:55)

The result of his revolutionary research was a detailed and exhaustive inventory of functional relations controlling the acquisition and extinction of conditioned reflexive behavior. In the wake of Pavlov's discoveries, progress in the science of behavior and learning was extremely energetic and productive, resulting in thousands of studies over the course of the 20th century.

In America, at about the same time Pavlov was making his mark on the history of psychology in Russia, Edward Thorndike (1911/1965) was systematically studying voluntary or instrumental behavior at Columbia University (see *Instrumental Learning* in Volume 1, Chapter 7). Thorndike and coworkers made numerous detailed observations on how animals learned to escape from puzzle boxes by manipulating various ropes and levers. Whereas Pavlov's work focused on the effects of antecedent stimuli on reflexive behavior, Thorndike was more interested in how instrumental behavior was affected by its consequences. In short, Thorndike believed that animals learned how to escape from puzzle boxes through a process of *trial and error* (perhaps more precisely stated as *trial and success* and *trial and failure*) in which successful (rewarded) behaviors are *stamped in,* whereas unsuccessful (punished) behaviors are *stamped out.* Thorndike referred to this general principle as the *law of effect.*

According to Thorndike, all "learning is connecting." Trial-and-error learning is dependent neither on deliberate reasoning (insight) nor on the exercise of some specialized instinct but depends entirely on the selective stamping in or stamping out of relevant stimulus-response connections. Together, Pavlov and Thorndike formed the intellectual and methodological foundations for the experimental study of animal behavior and learning.

Another major contributor to the history of behaviorism was B. F. Skinner, whose efforts resulted in the development of a formal training theory based on the work of Pavlov and Thorndike. In 1951, Skinner wrote an important short article directed toward a lay readership concerning behaviorism and its relevance for animal training, entitled "How to Teach Animals." To my knowledge, this was the first time that the process of explicitly *shaping* dog behavior by using

conditioned reinforcement was systematically described. The method involved using a toy cricket (clicker) to selectively reinforce successive approximations of free-operant behavior in the direction of a desired response (e.g., the dog touching the handle of a cabinet with its nose). In this same article, Skinner also discusses various other operant procedures (e.g., backward chaining) used to organize complex behavioral sequences. This is an important article for novice trainers to study and absorb. In that same year, Keller and Marian Breland—early students of Skinner—announced that they had founded a new psychological discipline, using Skinnerian principles, devoted to the training of animals. Referring to this new field as "applied animal psychology" or "behavioral engineering," the behaviorists boasted that they were "in a position to outstrip old-time professional animal trainers" (Breland and Breland, 1951:202).

Despite the Brelands' energetic efforts and enthusiasm, their behavioral enterprises failed to advance much beyond the operant conditioning of a series of commercial animal exhibits (e.g., dancing chickens, rabbits playing a piano, and pigs placing wooden coins into a "piggy" bank) used to advertise animal feeds. In addition to their commercial efforts, the Brelands were also contracted to perform military feasibility studies (e.g., mine detection). Early in their career, they assisted Skinner in Project Pigeon and ORCON—an acronym for *organic control systems* (Skinner, 1960). Project Pigeon involved training a multiple-pigeon crew to guide a winged bomb (called a Pelican) by pecking rapidly at a target image displayed before them on a plastic disc. A very high rate of pecking kept the bomb on target, with each peck producing an electrical signal regulating a set of servomechanisms controlling the wings. Although the laboratory work was reportedly successful, the feasibility project failed to convince military officials of its suitability for actual deployment.

Despite the Brelands' early commercial success, operant conditioning (i.e., automated training) proved problematic as a practical means for controlling animal behavior. Several conceptual flaws and shortcomings proved distressing and humbling for these early pioneers of operant technology. In their influential article, "The Misbehavior of Organisms" (obvious wordplay on the title of Skinner's seminal text "The Behavior of Organisms"), they had to concede that the strict behavioristic account of learning proposed by Skinner was not adequate to explain many of their practical observations and training difficulties:

> Three of the most important of these tacit assumptions [held by behavior analysts] seem to us to be: that the animal comes to the laboratory as a virtual *tabula rasa,* that species differences are insignificant, and that all responses are about equally conditionable to all stimuli.
>
> It is obvious, we feel, from the foregoing account, that these assumptions are no longer tenable. After 14 years of continuous conditioning and observation of thousands of animals, it is our reluctant conclusion that the behavior of any species cannot be adequately understood, predicted, or controlled without knowledge of its instinctive patterns, evolutionary history, and ecological niche.
>
> In spite of our early successes with the application of behavioristically oriented conditioning theory, we readily admit now that ethological facts and attitudes in recent years have done more to advance our practical control of animal behavior than recent reports from American "learning labs" (1961:684).

More recently, Marian Breland (now Bailey), together with Bob Bailey, an ex-Navy dolphin trainer and associate at Animal Behavior Enterprises, have come out of retirement to give seminars and workshops for an enthusiastic following of "clicker" trainers. They have teamed together to stage a traveling chicken-training show, during which trainers are challenged to test their timing skills to shape chicken behavior.

Applied Dog Behavior

The momentum behind the "ethological facts and attitudes" alluded to by the Brelands was forged by the pioneering efforts of such ethologists as Konrad Lorenz and Niko Tinbergen. The origins of ethology, however, are rooted in the work of Charles Darwin. *The Expression of the Emotions in Man and Animals* (1872/1965) was especially influential in this regard. In this

book, Darwin described and cataloged many of the common social displays exhibited by dogs. He argued that social animals, including dogs, evolve innate species-typical communication systems to meet habitual social demands placed upon them. Following in the example set by Darwin, Georges Romanes collected a variety of dog-related anecdotes and used them to support the notion of a continuity in the evolution of human and animal behavior. Romanes argued that dogs had evolved a high level of intelligence and other humanlike abilities. These highly interesting reports were obtained from a variety of correspondents and published as a collection in *Animal Intelligence* (1888). Another early figure of considerable importance in this regard is William James (1890/1950). Like Darwin and Romanes, James illustrated many of his psychological principles and theories with stories and examples taken from observations of dog behavior. Similarly, C. Lloyd Morgan, the author of several books on animal behavior and learning, performed hundreds of experiments with his personal dogs. He has been credited with introducing the concept of *trial-and-error learning* to describe the way his fox terrier, Tony, learned how to open a latched gate with his head (Gregory, 1987). In one of his texts, *An Introduction to Comparative Psychology* (1903), Morgan extensively illustrates and amplifies various psychological concepts and principles with numerous experiments and interesting observations of dog behavior and learning.

The application of comparative psychology, learning theory, and ethology in the treatment of behavior problems has only slowly taken form. An early effort to organize the available scientific information about dogs was made by F. J. J. Buytendijk (1936), whose book, *The Mind of the Dog,* contains especially interesting material on olfaction and other sensory abilities exhibited by dogs. In 1955, Konrad Lorenz published *Man Meets Dog,* a popular examination of dog evolution and behavior from the viewpoint of ethology. Many of Lorenz's ideas are dated, but his evident love and appreciation for dogs is an inspiration that continues to exert a profound influence. In that same year, Heini Hediger (1955/1968) published a valuable contribution to animal-training literature. In *The Psychology and Behaviour of Animals in Zoos and Circuses,* he describes animal training in terms of its ethological and scientific significance. Hediger emphasized the importance of animal training as a means for achieving a more complete understanding of animal behavior and maximally intensifying the human-animal relationship.

An important advance in the study of applied dog behavior and genetics occurred with the founding of Fortunate Fields in Switzerland by Dorothy Harrison Eustis. The large project, under the scientific directorship of E. Humphrey, aimed at developing an ideal working dog through selective breeding and training (Humphrey and Warner, 1934). Pioneering efforts in the study of dog behavior and genetics were also carried out by L. V. Krushinskii (1960) in Russia. In the United States, J. P. Scott and J. L. Fuller at the Jackson Laboratory (Bar Harbor, Maine) directed basic research into the genetics and ontogeny of social behavior in the dog. Their studies lasted over a decade and culminated in the publication of their highly influential text *Genetics and the Social Behavior of the Dog* (1965). Finally, as previously mentioned, in 1967 the Biosensor Research Program brought together numerous consultants and advisors (e.g., Michael Fox) to breed, socialize, and train an improved military working dog.

An early veterinary effort to apply the findings of experimental psychology to dog behavior and training was pioneered by L. F. Whitney (1961, 1963). In his book *Dog Psychology: The Basis of Dog Training,* he describes and illustrates many of the basic learning principles promulgated by Pavlov and Skinner. Whitney's effort was significant in terms of introducing modern behaviorism and training theory to the dog-fancy culture and bringing lure and clicker training to the attention of dog owners, thereby providing an alternative to the more force-oriented methods prevalent at the time. Unfortunately, Whitney was not well versed in the finer points of behavior analysis and its application.

During the 1970s, a number of historically significant texts were published. Prominent among these authors was Michael L. Fox, a veterinarian and psychologist. Fox was an

energetic experimentalist who published numerous articles and books on the normal and abnormal behavior of dogs and wolves. He was particularly interested in developmental processes and the comparative study of domestic and wild canids (Fox, 1971). Another respected contributor to the dog behavior literature of the time was Eberhard Trumler (1973), a student of Lorenz. Trumler brought the benefit of scientific training in ethology together with many years of close observation of dog behavior. Trumler's book provided a valuable source of information for many dog trainers and counselors. Finally, F. J. Sautter and J. A. Glover (1978) wrote a useful introduction to learning theory and the experimental study of dog behavior. Their book, subtitled appropriately, *A Primer of Canine Psychology,* neatly brought together an impressive body of scientific literature relevant to dog behavior, training, and development.

In the early 1960s, Dare Miller (1966), founder of the Canine Behavior Center in Los Angeles (Brentwood), California, began to employ various behavioral techniques to manage and control dog behavior complaints. Miller, who referred to his training and counseling practice as *dog psychology,* emphasized the role of frustration and anxiety in the development of behavior problems. Miller also appears to have believed that dog behavior maladjustment reflected human psychiatric problems: "One can only be sure of curing a dog if one has first psychoanalyzed its owner" [quoted in Mery (1970)]. In the early 1970s, W. E. Campbell (a protégé of Miller at the Canine Behavior Center) wrote a series of controversial articles concerning dog behavior for the journal *Modern Veterinary Practice.* Subsequently, a spate of articles written by veterinarians specializing in the treatment of companion animal behavior problems began to appear in professional veterinary journals.

Since then, a handful of veterinary behaviorists have written hundreds of articles, as well as several books, on the subject of animal behavior, including one text devoted to clinical behavioral medicine. Although noteworthy and stellar exceptions exist, the vast majority of these reports and studies involve case histories and the description of various treatment protocols. In addition, because the findings of most of these reports are based on very small samples, frequently involving just one animal, validation through statistical analysis is not possible. Until recently, few studies incorporated adequate experimental controls and none (to my knowledge) used blinded trials or reversals. As a result of these shortcomings, the veterinary behavior literature lacks convincing scientific authority, being largely the accumulation of anecdotal evidence, clinical impressions, and untested hypotheses (Appleby and Heath, 1997). In recent years, a trend in the direction of more careful research (including blinded trials) and the collection of statistically analyzable data has become more fashionable in the field. To some extent, this change of emphasis in veterinary behavioral research has been the result of pressures (and money) from pharmaceutical companies seeking quality scientific data with which to convince governmental authorities to license drugs for the treatment of animal behavior problems. Another likely incentive explaining this promising change was the American Veterinary Medical Association's decision in 1993 to recognize behavioral medicine as a veterinary specialty. With the advent of such recognition and respectability came the attached responsibility of situating this emerging field upon more scientifically responsible foundations.

While behavioral counseling and training have long been provided by professional dog trainers, the explicit application of psychological principles to such problems was heralded by the publication of a brief article entitled "Animal Clinical Psychology: A Modest Proposal" (Tuber et al., 1974) and a similar one written for a broader readership in *Psychology Today* published the following year (Tuber and Hothersall, 1975). In these articles, the authors (comparative psychologists and a veterinarian from Ohio State University) described several case histories and behavioral protocols used to treat problems such as thunder phobias and separation anxiety. The authors urged their colleagues to take up the banner of applied animal psychology and turn their skills and knowledge to the treatment of animal behavior problems. Unfortunately, only a scant few actually responded to their challenge by offering their professional ser-

vices to owners with problem pets. Apparently, graduate students at Michigan State University (MSU) got the message, with three of them going on to make major contributions to the field of applied animal behavior after obtaining their doctorate degrees: Henry Askew, Peter Borchelt, and Daniel Tortora. All attended MSU during the late 1960s and early 1970s while studying comparative and experimental psychology under the tutelage of M. Ray Denny and Stanley Ratner (Nitschke, personal communication, 2000).

Given its auspicious beginnings and favorable media attention, the field has attracted only modest interest and support from the academic community outside of veterinary schools, with very few accredited programs currently offering professional training in applied animal behavior science. The field has developed more or less independently of applied behavior analysis and other scientific disciplines that could have offered valuable conceptual principles, research tools, and behavioral techniques for its advancement and wider academic acceptance. Currently, very little funding is allocated to applied animal behavior research, placing strong constraints on its competitive viability and thwarting its ability to produce quality research. One result of these circumstances is that very few of the current therapies used by applied animal behaviorists have received rigorous scientific validation. In 1991, the Animal Behavior Society (ABS) formed an accreditation committee with the authority to certify applied animal behaviorists. ABS certification is based on academic qualifications and experience but does not require qualifying examinations.

In 1998, the American College of Applied Animal Behavior Sciences (ACAABS) announced its intent to certify applied animal behaviorists based on academic credentials, practical experience, and a qualifying examination. A subsidiary of the American Registry of Professional Animal Scientists (ARPAS), the college was formed to enhance the level of professionalism in applied animal behavior and to increase the competency of practitioners providing services in the field. Objectives of the college include establishing postgraduate education and experience requirements for certification, examining and certifying applied animal behaviorists, promoting continuing education, stimulating relevant research, and facilitating the dissemination of knowledge of applied animal behavior. In addition to educational and experiential requirements, certification depends on the candidate successfully passing a Diplomate Certification Examination. Currently, the ACAABS is primarily composed of animal behaviorists working with large animals, but will likely become more attractive to applied animal behaviorists working with family dogs and cats in the future.

Contemporary Trends in Dog Training

Operant techniques have been widely employed in the animal entertainment industry. In addition to the Brelands already discussed, animal trainers like Ray Berwick (1977) of Universal Studios employed operant procedures to train a variety of animals to perform on screen and television. Berwick's film credits include *The Birds* and *Birdman of Alcatraz.* Berwick's popular animal-training book outlines various clicker training procedures and included a tin clicker for use by the reader. Operant training paradigms have also been employed in the training of sea mammals. A noted sea-mammal trainer who has attracted considerable public attention for her work is Karen Pryor. In her autobiography *Lads Before the Wind* (1975), Pryor recounts her development as an animal trainer, describing in close detail the application of operant technology to the training of dolphins. She has written an influential self-help text (Pryor, 1985) in which she outlines the basic behavior analytical methods used for controlling human and animal behavior. However, Pryor is mostly recognized in the dog world for having championed and refined the clicker training method first introduced to dog owners by Whitney in the early 1960s. Squier (1993) has written a valuable review of Pryor's contribution as an animal trainer, outlining and discussing the major points of her training system. Another influential contemporary figure is Ian Dunbar (1979), a veterinarian and psychologist. A popular and charismatic speaker, he has presented numerous seminars over the years, reaching thousands of listeners with his

dog-training philosophy. Following in the tradition set out by Pearsall, he has been a strong advocate of early puppy training and socialization classes.

Finally, the American Humane Association (AHA) has facilitated efforts to develop humane guidelines for the dog-training profession. In March 1998, a task force of 22 dog trainers and behaviorists, animal care professionals, and humane workers was convened by the AHA in Denver, Colorado. In November 1998, several advisory working committees met together in Valley Forge, Pennsylvania, for the purpose of producing humane dog-training guidelines. While embraced by many dog-training and dog-related organizations, the project has recently attracted significant controversy following the publication of an article in *DVM Newsmagazine* in which a portion of the unpublished humane guidelines document was released to the public (Brakeman, 2000). The document is currently undergoing a final review and revision process that will hopefully succeed in making it more acceptable to the dog-training community.

Over the years, numerous popular books and magazine articles have been written by professional dog trainers in an effort to educate the dog-owning public about general obedience training and the management of common behavior problems. By necessity, much of importance in this regard has been left out of this brief history. My hope is that this chapter has provided the readers with a broad overview of some important contributions leading up to current practices and theory employed by professional dog trainers and behaviorists. A comprehensive and thorough treatment of the history of dog training and behavioral counseling remains to be written.

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2

Behavioral Assessment

Faust:
Thou'rt right indeed; no traces now I see
Whatever of a spirit's agency.
'Tis training—nothing more.

Wagner:
A dog well taught
E'en by the wisest of us may be sought.
Ay, to your favour he's entitled too,
Apt scholar of the students, 'tis his due!

JOHANN W. VON GOETHE, *FAUST* (1808)

BEHAVIOR ADJUSTMENT problems occur at all ages and involve practically every major canine behavior system. Naturally, given the evolutionary divergence between humans and dogs, one would expect significant tensions and conflicts to arise from time to time resulting in development of behavior problems. Although some of these problems can be quite serious and difficult to resolve, the vast majority are relatively innocuous and highly responsive to remedial training. Unfortunately, though, even minor adjustment

BEHAVIORAL ASSESSMENT

Descriptive	Functional
• What?	• How?
• When?	• Why?
• Where?	

FIG. 2.1. Behavioral assessment involves both careful description and functional analysis.

problems can be life threatening for a dog. Every year, approximately 2 million dogs are killed in U.S. shelters, many of them dying unnecessarily as the direct result of an unresolved behavior problem (Patronek, 1996). In addition, large numbers of otherwise healthy companion dogs are euthanized by veterinarians because of an intractable behavior problem (see *When the Bond Fails* in Volume 1, Chapter 10).

Understanding how dog behavior problems develop is central to designing effective prevention and training programs. Behavior problems develop under the influence of a complex web of biological and experiential influences. Accurately determining what these causal factors are has a direct bearing on the ultimate success or failure of behavior modification and therapy; acquisition and organization of pertinent information is vital to this process (Danneman and Chodrow, 1982). Broadly speaking, such information falls into one of two broad categories (Figure 2.1): descriptive (what, when, and where) and functional (how and why). As will be reiterated throughout this text, failure to appreciate fully the complex etiology of behavior problems adversely affects both the quality of assessment efforts and the efficacy of training recommendations. A thorough descriptive and functional assessment includes interviews, direct observations, and detailed medical and behavioral information obtained through questionnaires.

PART 1: DESCRIPTIVE AND FUNCTIONAL ASSESSMENT

BEHAVIORAL FACT-FINDING

An important source of behavioral information is the questionnaire (see the samples below). Relevant questionnaires are generally sent to the client, completed, and returned in advance of the first session with a dog. In addition to questionnaires, behavioral fact-finding involves both *interviewing* and *observing* techniques, with the most adequate picture being obtained by employing all three strategies. Interviewing techniques typically involve asking relevant questions over the telephone and in person. Observing techniques usually involve noting how a dog interacts with its owner and the home surroundings, as well as assessing how it responds to the trainer, unfamiliar people, animals, and other environments away from the home. Additional observing techniques include photographs, audio recordings, and videotapes. Finally, although not always practical, whenever possible, it is highly desirable to observe the dog engaging in the unwanted behavior.

Telephone Interview

The initial telephone call is important for both clients and dog behavior consultants. For clients, seeking help is often the culmination of a rather involved process. A safe assumption is that a client has already given considerable thought to the dog's problem and has probably tried many things in a haphazard sort of way, perhaps already trying professional advice that may not have worked. Picking up the phone and making the call is a major commitment to do something constructive about the dog's behavior. Unfortunately, poorly skilled counselors may take this opportunity to shame and criticize clients for their shortcomings and ignorance, rather than giving them the support and encouragement that they need to succeed. As the result of personal feelings of guilt and embarrassment, dog owners may be highly sensitive and vulnerable to such treatment. Effective counselors maintain a "relaxed, congenial, and non-judgmental" atmosphere during the interview process (Voith, 1980). Finally, the initial conversation leaves the client with a lasting impression of the counselor's professionalism and attitude—an impression that can facilitate or impede future counseling and training efforts.

The telephone interview offers a valuable opportunity to obtain candid information about the client, the dog, and the problem sit-

uation. From this initial contact information, tentative diagnostic and prognostic hypotheses can be formed. Perhaps the most important aspect of the telephone interview is the opportunity it gives a dog behavior consultant to assess the situation and to decide whether to accept or to decline a case. The decision to accept or decline is a professional and ethical prerogative based on numerous factors, but such decisions especially depend on the trainer's qualifications to deliver the required information and skills needed to resolve the problem successfully. *The ability to recognize the limits of one's craft is a true sign of professionalism.* In addition to an ethical responsibility toward their clients and the dogs, trainers also have an ethical responsibility to public safety and should decline cases in which there exists doubt about the possibility of success or where significant danger outweighs the potential benefits of intervention. For example, an owner calls reporting a situation in which a recently adopted dog, without much warning or provocation, attacked a visiting child, biting the child severely in the face (leaving several deep lacerations and puncture wounds). In response to such information, the behavior counselor should outline the legal and public safety risks associated with owning such a dog. In addition, care should be taken to emphasize the limited state of current knowledge about dog behavior, especially with respect to the prediction and control of aggression. The proper disposition of such a case will depend on the client receiving reliable information and direction from various professionals, including the trainer, veterinarian, and attorney. Although the telephone interview may provide sufficient information to form such decisions, it is preferable in most cases to meet with the family and the dog in person to assess the situation and evaluate the risks properly.

In another hypothetical situation, the initial call may involve a dog exhibiting destructive behavior and excessive barking when left alone. As the conversation moves along, however, the client may confide in passing, "Oh yeah, Sparky is sometimes a little unpredictable with strangers, especially when they first enter the house." The client may go on to describe how the dog is usually friendly, but only after he has had a chance to calm down and "make friends on his own terms." Obviously, without such information, the behavioral counselor might very well become Sparky's next victim, without ever knowing that a danger even existed.

When clients describe their dog's behavior problem, it is often expressed in subjective terms, for example, "The dog becomes spiteful when I leave him alone;" "He is so sweet most of the time, but then all of sudden—wham;" "He likes most people, but sometimes he just goes ballistic." Surprisingly, although tainted by anthropomorphism and sentimentality, clients' assessments are often very useful and well considered (demonstrating that they have thought a lot about the problem before calling), and they are often able to remember and express the finest detail—if they are given a fair chance to do so. Although the interview must be structured and guided to get the most out of the process, unnecessarily interrupting or interjecting opinions and comments that might wait should be avoided, at least during the early stages of the conversation. It is of utmost importance to allow clients to express their opinions fully and to feel comfortable while doing so. To accomplish this, counselors should remain open-minded and avoid counterproductive criticism and moralizing. One way to be supportive over the phone is to acknowledge the client's insights and efforts with brief comments of understanding and active interest in what they are saying. Remaining distant and quiet while on the phone only serves to alienate clients, make them nervous, and increase their awkwardness and embarrassment, perhaps causing them to withhold vital information. Finally, the quality of information obtained from interviews is strongly influenced by the way in which questions are asked (Hunthausen, 1994). Questions charged with judgmental innuendo should be avoided. Once clients have expressed the problem in their own terms, counselors can restate the details in more objective behavioral terms.

During the telephone interview, basic information about the dog can be recorded on a worksheet, including such items as signalment (age, sex, sexual status, and

breed/mix), origin (breeder, pet store, friend, shelter, etc.), and age at adoption. Information about the presenting complaint should include the three W's (*what* happens, *when* does it happen, and *where* does it happen) and the three H's (*how* long, *how* frequent, and *how* severe). It is useful to emphasize the most recent occurrence of the behavior problem and, from there, organize contributory information around it as the interview develops. Of course, these various questions are preliminary to the private meeting in the home, at which time more detailed information can be obtained.

Another important function of the telephone interview is client education. Most dog owners seeking help for a behavior problem have little knowledge about what to expect and may have many concerns or fears about the training process and its likelihood of success. Sometimes a client is concerned that the dog will be physically hurt or its spirit broken by training. More recently, a growing number of clients want to be reassured that aversives *will* be used, having had exposure to previous training efforts in which a trainer refrained from the use of such procedures. Trainers should briefly explain how behavior modification works and the type and extent of aversives that are typically used, thereby allaying some of these worries and fears. Misleading or exaggerated statements about the relative role of rewards versus aversives may only serve to plant a seed of mistrust in the client toward the trainer-counselor, especially if the trainer ultimately needs to resort to aversive techniques to resolve a behavior problem. Besides providing some general information about the training process, trainers can also give clients a few useful preliminary tips in advance of the first meeting. Such information can be very helpful, plus everyone likes getting something for free.

Lastly, clients may also want some information about what to expect as the result of training. Although giving guarantees about behavioral change or boasting about one's successes is inappropriate, it is reasonable to discuss the likelihood of success in terms of past experience. Most consumers of behavioral advice are not looking for miracles; they are, however, looking for an honest assessment and a professional effort. A sure sign of professional incompetence and insensitivity is casually recommending euthanasia, over the phone, as a trivial matter. In cases involving aggressive dogs where training is not likely to be successful, the trainer should advise the client to contact a veterinarian for additional diagnostic evaluation and other possible options—options that may or may not include euthanasia. Ultimately, the option to euthanize a dog is a joint decision made by the client and the veterinarian, under the advisement of the trainer. The recommendation of euthanasia, if and when it is made, should be the outcome of a thorough behavioral and veterinary assessment of the dog.

Despite obvious limitations, under some circumstances, either because of travel distances involved or monetary constraints, the behavioral assessment and counseling process may need to be carried out over the phone or the Internet. In such cases, it is useful to provide the client with a detailed behavioral questionnaire and to set up a series of telephone appointments once the questionnaire has been returned and studied. Supportive information like videotapes, audiotapes, photographs, charts, and a behavioral journal are all very useful tools in the analysis of behavior problems at a distance.

Home Interview

Whenever possible, the counselor should interview family members and make direct observations of the dog's behavior in the home. The home interview is a continuation and refinement of the process initiated during the telephone interview. During the home interview, additional information is obtained that may not have been offered by the client during the telephone interview or not provided by the questionnaire. It is crucial to obtain detailed information about all previous efforts to resolve the behavior problem in advance of making specific recommendations. Once such information is in hand, the counselor may explore a variety of working hypotheses, more fully discuss treatment rationales, and establish realistic expectations about the likelihood of success. Of utmost importance is the counselor's ability to con-

vince the client that the counselor is able help. If the client-owner lacks confidence in the counselor's abilities and expertise, the process is bound to fail. Perhaps the single most important function of the home interview is to *prepare* a client family emotionally and psychologically to work through the behavior problem successfully. This process involves much more than simply informing clients about dog behavior and learning; it includes a great deal of sensitivity about their fears, disappointments, and attitudes about the process itself (Askew, 1996). In addition, clients must be made fully aware that behavioral change is not a magical nostrum, but a systematic and logical process that sometimes demands personal commitment, self-sacrifice, and a readiness to change one's own behavior in order to modify the dog's behavior. Without pointing fingers or resorting to shaming tactics, counselors should carefully explain that behavior is a dynamic reflection of the interaction between the dog and the environment, especially the social interaction between the client family and the dog. To change a dog's behavior, the behavior of people interacting with the dog may also need to change. Although changing a dog's behavior is the ultimate goal (and many means are provided to clients to achieve that end), to obtain lasting change, consistent with cynopraxic goals (see Chapter 10), a client's perception and behavior toward a dog may also require significant modification. Finally, the physical environment may also require alteration. Consequently, the home interview involves asking questions about where the dog spends most of its time: where it eats, sleeps, plays, and is exercised and trained.

Successful counselors are attentive and empathetic listeners who exhibit a sincere interest and caring attitude about clients' difficulties in controlling their dog or failure to form a satisfying relationship. Such understanding and accommodation helps to mediate a trusting rapport between the counselor and the dog owner. Instilling guilt or shaming an owner provides little productive incentive for the owner to change the situation. Instead of assigning guilt and shame, clients should be assigned a positive and realistic sense of responsibility for their dog's behavior and well-being. From a cynopraxic perspective, the client family is held responsible for stewarding constructive change—not for past shortcomings.

Defining Behavior as a Problem

First and foremost, identifying a behavior pattern as a *problem* involves a cluster of cultural and personal preferences and normative judgments. These judgments reflect the client's attitudes and expectations, current scientific understanding, societal mores about animal behavior, and costs (economic and emotional) associated with the dog's behavior. A behavior problem is a tendency or pattern of behavior that sufficiently deviates from the owner's expectations or society's norms that efforts are prompted to change it into a more acceptable form. Behavior that fits our norms and expectations is considered normal and acceptable, whereas behavior that deviates too far from them or produces excessive costs for society or dog owners is deemed unacceptable or abnormal. Of course, there is considerable room for debate with respect to what clients may consider abnormal and unacceptable versus what society considers abnormal and unacceptable.

This general model accommodates problems ranging from minor adjustment issues and nuisances to major behavioral maladaptation such as aggression and compulsive habits. According to this model, some behavior problems may simply stem from a client's idiosyncratic preferences or misunderstandings of normal dog behavior, rather than from a behavioral symptom of a disorder or pathological state. What may be agreeable to one client and situation may be unacceptable to another person living under different circumstances. In some cases, an owner may view a particular behavior as being highly objectionable and unacceptable, until its ethological or functional significance is explained. In this case, the owner misinterpreted a normal behavior as representing a problem. At the other extreme, a highly unacceptable behavior may be defended by a client (a common situation involving aggression cases) until its characteristics and implications are properly

Before Training

Prefers aggressive play and chase games	X O • • • • •/• • • • • 0 0.5 1.0	Likes petting and gentle play

Expectancy Deviation Score: 0.7

After Training

Prefers aggressive play and chase games	X O • • • • •/• • • • • 0 0.5 1.0	Likes petting and gentle play

Expectancy Deviation Score: 0.2

FIG. 2.2. Expectancy deviation scores can be used to identify and quantify problem areas, as well as to provide a measure of behavioral change and improvement resulting from counseling and training.

interpreted and understood. Consequently, an important aspect of cynopraxic intervention involves educating clients about normal dog behavior, adjusting their perceptions and misunderstandings, and, when necessary, facilitating more realistic expectations about the dog's behavior.

Assessing behavior problems includes objectively evaluating how the unwanted behavior affects a dog's quality of life, the client's needs (including bonding issues, safety, and preserving personal belongings and surroundings), and society's prerogatives (especially safety and health). One way to quantify a behavior problem that reflects the foregoing parameters is by identifying and assigning a value to a client's dog-behavior ideal and then identifying on the same behavioral continuum or trait what best represents the dog's actual behavior. Behavioral profiles measuring expectancy convergence/divergence provide a valuable means for assessing interactive conflict (see the *Puppy Behavior Profile*). The *Puppy Behavior Profile* is an especially useful tool for assessing puppy adjustment problems. Figure 2.2 shows a sample pretraining and posttraining profile. Clients are instructed to place an X over the point on the continuum that best describes their puppy's behavior and an O over the point that best represents their ideal. The upper half of the sample profile indicates at the outset of training the existence of a significant deviation between what the client expects from the puppy and what the puppy actually does. In the lower half of the sample, posttraining measures show a strong shift and convergence between the client's expectations and puppy's actual behavior. These changes can be quantified by assigning numerical values to the owner's ideal and their perception of the puppy's actual behavior. In the case of the pretraining profile, subtracting the larger value (0.9) from the smaller value (0.2) yields an expectancy deviation of 0.7. A similar calculation applied to the posttraining sample yields an expectancy deviation of 0.2. By comparing assessment data from the outset of training with data obtained at the conclusion of training, a quantified measure of change can be obtained to demonstrate the benefits of cynopraxic intervention. When a dog's behavior closely converges with its owner's expectations, the level of conflict between the owner and dog is obviously reduced, and presumably the social bond is more secure. Conversely, if the owner's expectancies strongly diverge from the dog's behavior, the bond may be threatened or, perhaps, destroyed over time by serious and unresolved conflict.

In addition to obtaining a behavioral expectancy profile, detailed questionnaires and direct interviews (both over the telephone and in-home) give a dog behavior consultant a fuller picture of the client's perception and understanding of the situation. Of course, nothing can take the place of directly observing a dog's behavior and the controlling environment. Furthermore, since a client's judgment is often clouded by the influence of

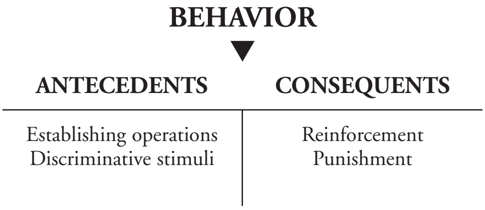

FIG. 2.3. Behavior is functionally dependent on controlling antecedents and consequents.

various factors such as anthropomorphism, inexperience with dogs, hearsay opinions, and cultural biases, the cynopraxic counselor is well advised to observe the dog in the home whenever possible.

Functional Analysis and Working Hypotheses

To organize and mediate behavioral change, a dog's problem behavior must be objectified and assessed in terms of its biological and adaptive significance (Voith and Borchelt, 1996). Most behavior problems develop within a context of complex influences involving both biological (nature) and experiential (nurture) factors. Identifying the antecedents and consequences controlling the expression of unwanted behavior is a major consideration in the assessment of any behavioral complaint (Figure 2.3). A guiding principle here is the notion that behavior functions under the control of antecedent variables (e.g., eliciting stimuli, discriminative stimuli, and establishing operations) and the influence of consequences produced by the unwanted behavior (e.g., marking events, positive and negative reinforcement, and punishment). Table 2.1 shows the various steps taken to perform a functional analysis of unwanted behavior. Objectively speaking, behavior problems present one or more of three general failings: (1) not enough (a deficiency in some pattern of behavior), (2) too much (an excess of some behavior), or (3) intrusion (behavior expressed under inappropriate circumstances).

Forming a working hypotheses about the functional significance of the unwanted behavior provides counselors with a rational foundation for behavioral intervention. From the working hypothesis, a training plan is designed, implemented, and tested. The training plan should include a functional evaluation of the various contributing instrumental and Pavlovian factors involved (obtained from the history, interview, and direct observation of the dog's behavior), as well as any significant ethological considerations believed to play a role in the expression of the unwanted behavior. It is often useful to search the literature for updated scientific information relevant to the problem before formulating a training plan. Finally, specific criteria should be decided upon in advance for assessing the general success or failure of the training plan. Although moving haphazardly from hypothesis to hypothesis is not appropriate or very constructive, it is often necessary to adjust assumptions about a dog's behavior based on its response to behavior modification and training. In fact, a dog's response to training serves either to confirm or to disconfirm the working hypothesis or behavioral diagnosis.

Dead-dog Rule

Ogden Lindsley (1991) has argued that behavioral assessment is properly limited to the occurrence of some activity or accomplishment, rather than specifying the absence of behavior, that is, something that a dead man is able to do. He argues that something a dead man can *do* is not behavior at all in the proper or analytical sense of the word. The "dead-man test" was proposed by him as a litmus test for determining whether some target represented a proper objective for behavior modification. Putting aside some questionable theoretical implications, the dead-man test offers a practical means for identifying behavioral goals and assessing change. The dead-dog rule is a hybrid variant of Lindsley's test, but departs somewhat from it in terms of emphasis and application. For one thing, the absence of behavior is not always an improper object of assessment, especially in the case of punitive contingencies, where the primary goal is to suppress behavior, that is, to render absent some behavior. According to Lindsley's test, however, the absence of responding is something a dead man or dog can do and, therefore, is not behavior. Also, some limits

TABLE 2.1. Steps in performing a functional assessment

1. Obtain a detailed history of the problem together with various contributing factors such as general health and nutrition.
2. The stimuli and situations under which the unwanted behavior occurs or does not occur are identified. These include motivational considerations (e.g., establishing operations), discriminative stimuli, and classically conditioned triggers. Contextual factors should also be given careful consideration, since many behavior problems are highly contextualized.
3. Identify biological predispositions (e.g., temperament) and ethological considerations that contribute to the expression of the target behavior.
4. Identify and compile antecedents (see item #2) and consequences (e.g., inadvertent or bootleg reinforcement) and other potentially aggravating influences (e.g., competitive tensions and attention-seeking behavior) existing between the owner and the dog. This list should include both current contingencies of behavior reinforcement as well past behavioral influences controlling the behavior.
5. Obtain a baseline of the unwanted behavior (estimated frequency and magnitude—both informal and formal, as needed).
6. Whenever possible, directly observe the unwanted target behavior.
7. Discuss all past efforts to change the behavior.
8. Develop a working hypothesis or set of hypotheses about the functional antecedents and consequences presumed to be operationally significant with respect to the occurrence of the undesirable behavior.
9. Develop a training plan or strategy of intervention based on a working or *diagnostic* hypothesis.
10. Assess the training plan or strategy in terms of the effect it has on the occurrence of the unwanted behavior.

set on behavior imply the absence of behavior without necessarily specifying an alternative behavior: the unwanted behavior is simply blocked (response prevention), suppressed (punishment), or extinguished (the reinforcing contingency is discontinued). Further, a dog can learn to lay quite still as though dead, something an actual dead dog *does,* but in the former case staying still is certainly an active behavior that is controlled by reinforcement. Perhaps, more properly stated, the objective should not be to train the dog *not to move* (something a dead dog can do), but to train the dog to stay for some limited duration of time—something a dead dog cannot do. The dead-dog rule is used as prescriptive measure and means to specify training goals in affirmative terms, rather than serving as a litmus test or theoretical position regarding behavior per se.

In contrast to punishment training, the goal of reinforcement training is either to increase or produce some target behavior, not eliminate it. For example, according to the dead-dog rule, the objective of training a dog not to jump on guests is better stated in terms of alternative behavior incompatible with jumping up, that is, sitting, standing, or walking about in the presence of guests. When using a reinforcement contingency (positive or negative), defining the behavioral objective in negative terms (that is, no jumping) violates the dead-dog rule, since *not jumping* is something a dead-dog can do. In the case of reinforcement training, the dead-dog rule holds that behavioral objectives should be described in affirmative terms rather then negative ones, that is, in terms of an absence of behavior. Punishment, extinction, and response prevention result in a reduction or elimination of behavior, whereas reinforcement results in an increase or production of behavior. In some cases, the absence of behavior is not an adequate or reliable objective for behavior modification. This is especially true in the case of aggression. Remembering that

reinforcement training results in an increase or production of some behavior, it makes little sense to define behavioral objectives occurring as the result of reinforcement in terms of an absence of behavior. Reinforcement cannot eliminate behavior, except in a secondary way; reinforcement is productive of behavior and, consequently, behavior operating under the control of reinforcement contingencies should be assessed in affirmative behavioral terms. Consequently, the goal of reinforcement training is not to suppress aggression but to facilitate and reinforce behavior incompatible with aggression—arguably the most successful means for modifying such behavior problems. Therefore, successful intervention should be assessed in terms of affirmative changes in behavior, such as increased levels of affectionate interaction, friendly displays, and cooperation—not the absence of threats and aggressive episodes. The dead-dog rule is applicable here since a dead dog neither threatens nor bites. What a dead dog cannot do is to exhibit increased affection, friendliness, and cooperative behavior. In general, the absence of aggression is an inadequate criterion for measuring treatment success, although it is commonly used for such purposes. Instead, the objective of training should be to identify and strengthen behavioral tendencies and activities that are incompatible with aggression. Although punishment may be able to suppress aggression temporarily, it will probably not alter the motivational pressures causing aggression and may make the problem much worse and more difficult to resolve in the long run. Consequently, success should not be gauged by the absence of aggression, but by an increase of target activities that are motivationally and behaviorally incompatible with aggression.

Many other undesirable behaviors undergoing modification through positive and negative reinforcement procedures are often improperly assessed in violation of the dead-dog rule. For example, the goal of house training is most frequently described in terms of an absence of household elimination rather than the objective of training a dog to eliminate exclusively outdoors. The former violates the dead-dog rule (a dead dog does not eliminate indoors), but the latter formulation is in agreement with the dead-dog rule, that is, a dead dog cannot be expected to eliminate exclusively outdoors. Certainly, it is useful to count elimination incidents indoors and prevent or discourage their occurrence, but the primary focus of assessment and modification should be directed toward training the dog to eliminate outdoors.

Training Plan

The training plan addresses both antecedents as well as consequences believed to control the expression of unwanted behavior. In addition to assessing and altering unwanted behavior, trainers are also concerned with using antecedents and consequences to shape and control more desirable alternative behavior.

Evaluating the Training Plan

Obtaining baseline information is vital for evaluating the effectiveness of the training plan selected. The most common measures of behavioral change are rather informal. Initially, the client is asked such questions as how often, when, and where the target behavior occurs. Then, over the course of the intervention, various measures of change are taken, relying primarily on the client's impressions about the strength and frequency of the unwanted behavior. As previously discussed, a valuable baseline measure can be obtained by assessing the amount of deviation or dissonance between the owner's expectations of the dog's behavior and what the dog actually does. In general, a high degree of expectancy dissonance is correlated with client expressions of distress and disapproval, whereas a low degree of expectancy dissonance is reflected in expressions of pleasure and acceptance of the dog. Instruments used to assess expectancy dissonance also offer an objective means to quantify subtle interactive shifts between the owner and dog—changes that may otherwise pass undetected by other methods of quantification.

Methods of Measuring Behavior

These approaches are often adequate for practical purposes, but sometimes more detailed

and careful measures and analyses are needed. Behavioral change can be quantified by directly measuring behavior. Five methods for measuring behavior are employed: event recording, emission duration, absence duration, interval recording, and response strength. Event recording refers to the continuous counting of every occurrence and duration of the target behavior over the course of some fixed period of time. For example, before a specific training plan is implemented to reduce pulling on the leash, the trainer might count the number of times the dog pulls and record the duration of each pulling episode during a 15-minute walk. If the dog pulls a great deal, however, such measurements of discrete pulling episodes might not be very useful. In this case, the overall time spent pulling might provide more practical information about the target behavior. The target behavior can be expressed in terms of the percentage of time spent pulling. A trainer might not find either of these measures very convenient but instead choose to measure the amount of time during which the dog does not pull.

In cases where a target behavior occurs at a high rate, making counting impractical, or when several target behaviors need to be recorded at the same time, the trainer may prefer to employ an interval-recording strategy. Interval recording involves noting whether the target behavior occurs during a set (often very brief) period. Interval recording does not involve counting actual responses but only records whether the target response(s) occurred during the time interval under observation. In addition to rate and duration, the strength of the target behavior can also be obtained in some cases. For instance, the strength of pulling can be directly measured by attaching a pull-type scale to the leash. After every minute of walking, the trainer can record the amount of pounds of pull pressure exerted by the dog on the leash and then average the results. Such pretraining measurements give trainers an objective baseline of data with which to assess the benefits of the training plan, especially in cases in which such precise recording is needed to document a study evaluating the training procedure. Unless collecting data for specific research or testing an unproven procedure, most such measurements are roughly recorded in the form of journal notes or impressions that assist in evaluating or adjusting the working hypothesis and training plan.

In contrast to the typical *free-operant* methodology used in the learning laboratory, many dog-training activities involve *discrete-operant* training procedures. In discrete-operant training, a dog's behavior is brought under the control of a specific stimulus event (e.g., cue or command) that sets the occasion for the occurrence of some response and reinforcement. Once the target response is emitted and reinforced, the dog must wait to be released or signaled to perform some other task. Most obedience exercises are trained by using a discrete-trial methodology. In the case of free-operant training, the animal is free to respond at any time before or after reinforcement is delivered, although in practice the pattern of responding is strongly influenced by the schedule of reinforcement employed by the experimenter. Free-operant responding is measured in terms of frequency or rate. Rate of response is determined by recording the number of times the response occurs within a given period. Discrete-trial behavior is quantified in terms of a probability relationship based on the number of opportunities the dog has to respond and the number of times the appropriate response occurs. For example, if a dog responds 6 of 12 times it is signaled to sit, the probability of sitting is estimated by dividing 12 into 6, or 0.5 (i.e., he sits 50% of the time). In everyday practice, such calculations are rarely made regarding the performance of obedience exercises, but this method is useful for quantifying obedience training when a stringent measure is required.

Single-subject Designs for Assessing Behavioral Change

In addition to expectancy-dissonance measures, there are several general strategies for estimating the benefits of training and the efficacy of the procedures used to control behavior, but all require some careful baseline measurements in order to generate a valid comparison between pretraining behavior and posttraining behavior. Once a baseline is established, the training plan

can be implemented and its influence measured at various points. In other words, the target behavior (dependent variable) is measured prior to the implementation of the training plan and then, again, after the training procedure (independent variable) under consideration has been employed. Changes in the strength or frequency of the target behavior presumably reflect an effect produced by the training procedure.

The single-subject design utilizes a dog's behavior as its own control for evaluating the benefits of training and counseling. In the single-subject design, baseline measures or A phase of the target response are compared with a training or B phase. Under conditions in which the effect of the training procedure is being stringently evaluated, the B phase is followed by the withdrawal of the training procedure (extinction or test A phase) or A-B-A (Figure 2.4). However, removing an effective training procedure is not an acceptable option when working with a family dog, especially in cases involving a serious behavior problem. Under normal training conditions, involving week-to-week sessions, each training session involves a distinct A phase and B phase, followed by a week interval during which the client practices the procedures with the dog—an extended B phase (EXT-B). The following week, a second assessment or A phase and another treatment or B phase is carried out. Finally, a third assessment and treatment phase is added to the process with the final session. The overall training program takes the form: A-B-(B-EXT)-A-B (EXT-B)-A-B-(EXT-B). . . Follow-up (Figure 2.5).

If the training plan is working effectively, each successive baseline measure should show significant improvement over the prior week. If improvement does not appear from week to week, then the training hypothesis and plan should be appropriately adjusted and reevaluated. Over the course of 3 weeks of training, a dog's behavior should exhibit a consistent trend toward improvement, that is, show

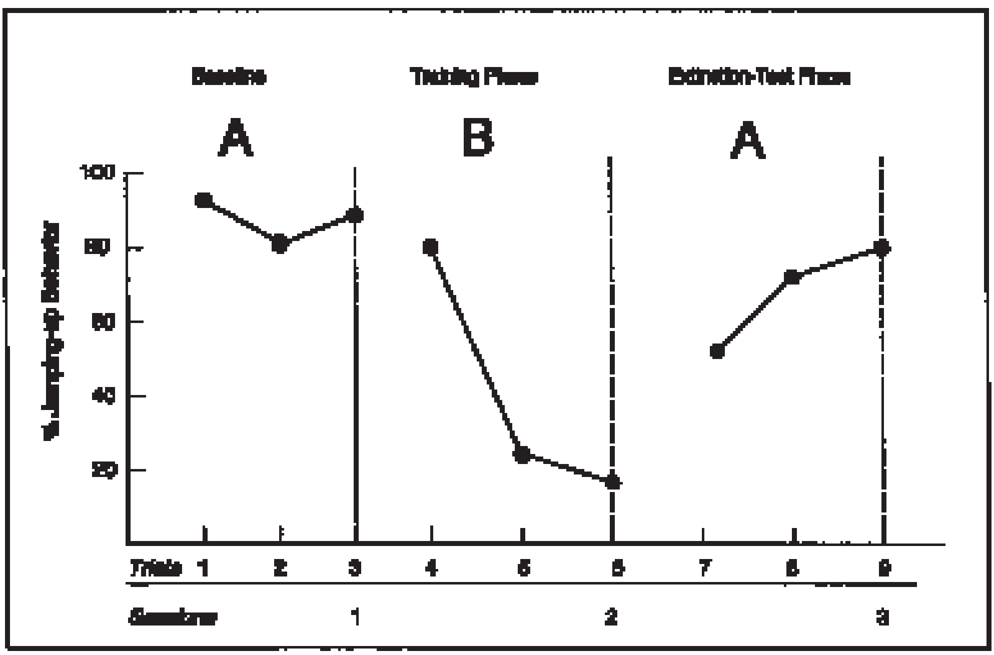

FIG. 2.4. Changes in jumping behavior resulting from the combined use of time-out and differential reinforcement of other behavior. The B or training phase indicates a strong reduction in jumping relative to baseline levels, whereas the test-extinction phase shows that jumping behavior recovers when the training procedures are discontinued.

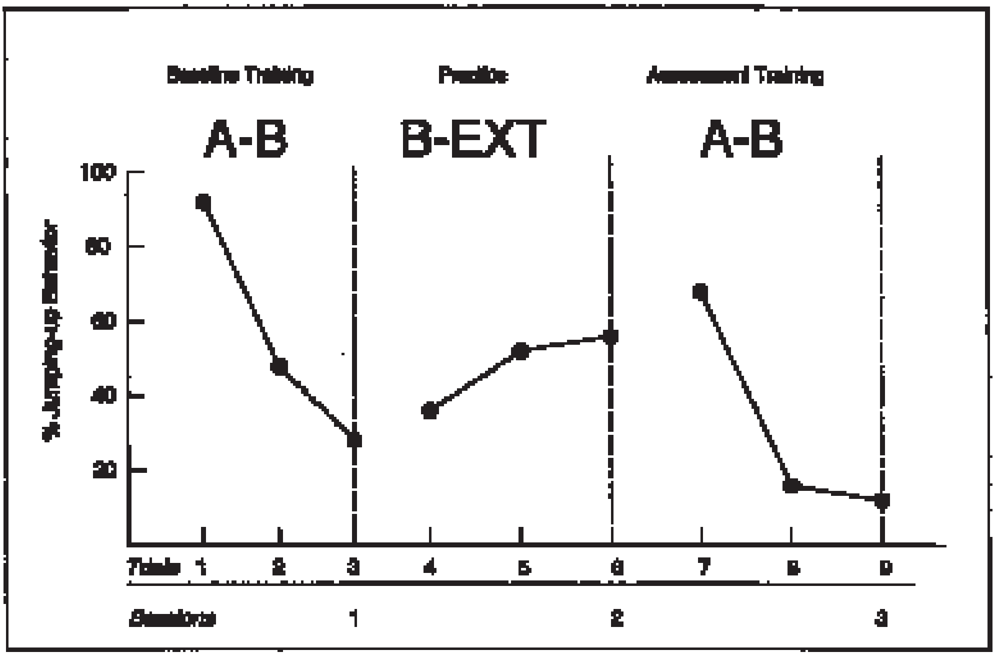

FIG. 2.5. Normally, every training session includes both a baseline phase and a training phase, with an extended B or practice phase between sessions.

evidence of less unwanted behavior and more desirable alternative behavior. Ideally, a monotonic learning curve climbs most steeply from week 1 to week 2 (acquisition phase), and more modest improvement continues between weeks 2 and 3 (adaptation phase), with gradual progress toward asymptotic levels (steady phase) after week 3 (Figure 2.6). The working hypothesis and the efficacy of the training procedures used are further validated by applying them to a larger sample of dogs exhibiting similar presenting signs. If a similar benefit is observed, then there is a high likelihood that the working hypothesis and training plan are producing an effect that is generalizable to other dogs with similar problems.

Although single-subject experimental designs [e.g., AB/AB reversal, multiple baseline, and alternating treatments—see Chance (1998) and Bellack and Hersen (1977)] and related assessment techniques are frowned upon by some researchers who demand a stringent statistical analysis of data, the techniques do offer a relatively simple way for dog behavior counselors and trainers to get a general picture of the effectiveness of an untested or questionable methodology. Such assessment techniques can be usefully employed to collect, evaluate, and report such behavioral data. From such information, reasonable hypotheses may then be formulated and, perhaps, tested in a more rigorous fashion.

The foregoing assessment techniques can be applied in a formal or informal manner, depending on the trainer's purposes or needs for collecting such data. These experimental methods and others are absolutely indispensable in canine behavioral research conducted to evaluate and compare the relative efficacy of various training and behavior therapy procedures. Unfortunately, very little such data and validation currently exists in the applied animal behavior literature. Most available reports to date consist of case studies in which complex behavioral interventions, involving a number of procedural elements (e.g., various behavior modification procedures or drugs), are assessed by obtaining clients' impressions of their dog's improvement. Such reports are typically descriptive narratives that include signalment,

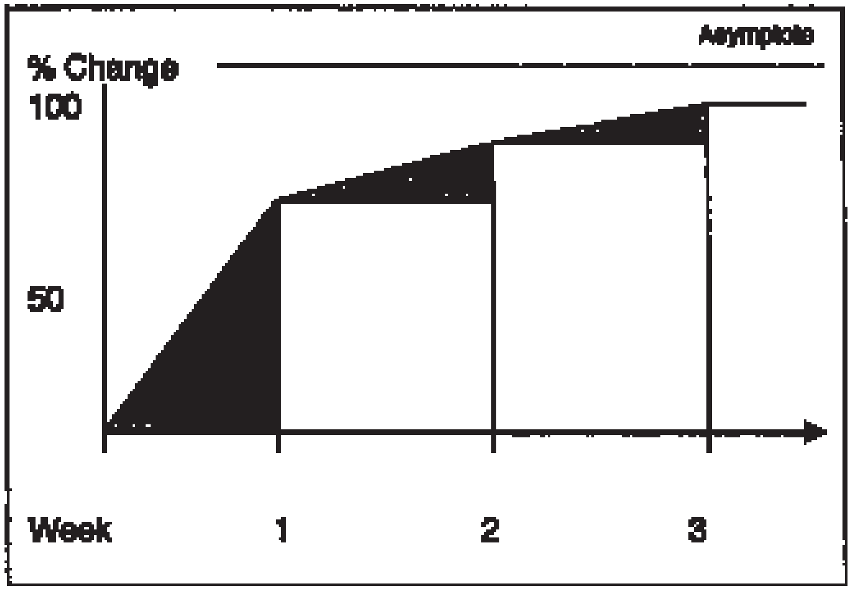

FIG. 2.6. The typical learning curve shows rapid acquisition, followed by more gradual adaptation and steady phases of learning.

the presenting behavior, diagnosis, treatment, and results—with virtually no supporting data. Further, few efforts have been made to control the obvious risks of placebo effects or a client's desire to please the experimenter with positive results. Although such information can be useful for stimulating further research, thus far case studies have not accomplished much more than to stimulate the publication of more case studies. The paucity of data is a serious problem for the field of applied animal behavior. Carefully employed single-subject assessment methods offer an excellent starting point for important data-based research.

Compliance

Client compliance depends on a number of factors, including the counselor's ability to convey a confident and knowledgeable attitude, to develop an accurate and convincing assessment of the presenting complaint, and to provide the client family with a treatment program that is minimally intrusive and disruptive. Further, all training recommendations should be realistic for the nonbehaviorist client to perform. *The training plan should be fully understood by the client and involve procedures that are within the ability of family members to apply.* Asking clients to do something that they consider cruel is not likely to be carried out when the counselor leaves the home. Also, recommendations that are impractical in terms of their daily schedule, skills, or knowledge will not result in effective intervention. This imperative for compliance is particularly important when working with children.

To be effective, the training plan must be sensitive to the family's needs and philosophy of discipline. No matter how brilliant and considered the plan, it will inevitably fall on deaf ears and fail if it is not accepted and followed by family members. For example, recommending that all family members withhold all sources of positive reinforcement and social interaction from their dog for the rest of its life, except, and only if, the dog sits on command and remains in a sit-stay for some period of time, would represent for many dog owners a rather bizarre, extreme, and unacceptable intrusion upon their autonomy and ability to enjoy their dog. For many owners of problem dogs, the above cure would be significantly harder to live with than the problem

itself. Treatment protocols recommending highly restrictive, arbitrary, and unnatural interaction between the owner and dog should be cautiously evaluated. Highly intrusive or aversive recommendations should only be implemented when scientific evidence both supports the treatment's rationale and its efficaciousness and, then, only under circumstances in which less intrusive or aversive means are unlikely to work. Under the protective veil of professional authority and pseudoscience, dog behavior advice having little therapeutic value may succeed in capturing the public's imagination and become widely dispersed. Unfortunately, as a result, more-effective methods may be overshadowed, leaving serious behavior problems untreated or worsened by neglect or mismanagement. Richard Dawkins (1976) has referred to such ideas and practices as *memes:*

> Just as genes propagate themselves in the gene pool by leaping from body to body via sperms or eggs, so memes propagate themselves in the meme pool by leaping from brain to brain via a process which, in the broad sense, can be called imitation. If a scientist hears, or reads about, a good idea, he passes it on to his colleagues and students. He mentions it in his articles and his lectures. If the idea catches on, it can be said to propagate itself, spreading from brain to brain. . . . When you plant a fertile meme in my mind you literally parasitize my brain, turning it into a vehicle for the meme's propagation in just the way that a virus my parasitize the genetic mechanism of a host cell. (192)

Memes are viruslike ideational contagions that seem to survive solely for the sake of their replication and perpetuation by infecting others. Although of questionable value, memes, when sanctioned by authority, can be surprisingly resistant to rational argument and persist despite the absence of scientific merit or proof of efficacy. Unproven, but highly popular, memetic protocols are common in dog training and may function on the level of magical incantations or rituals that may make people feel better with the illusion of accomplishing something. Memetic protocols may make people feel better with the illusion of accomplishing something (placebo effect) but probably do little to change the dog's behavior or to improve the human-dog bond. Whatever conceivable benefits (e.g., establishing deference, enhancing attentional abilities, or increasing impulse control) that might be achieved by the aforementioned sit-stay protocol, such benefits can be obtained by more creative and enjoyable means, including techniques that the average family might be expected to willingly perform. For example, Voith and Borchelt (1982) describe a sit-stay protocol that has enjoyed significant popularity over the years. Although their so-called "nothing in life is free" (NILIF) program emphasizes a sit-stay contingency to promote behavioral compliance, the NILIF program is not promulgated as an absolute or lifelong imperative to ensure the remission of the problem behavior. In general, the significant issue at stake is not sitting and staying per se, but the development of a rule-based structure for facilitating harmonious interaction between the owner and dog. By ensuring that the dog attends to and consistently defers to the owner's directives, the owner's leadership is enhanced while interactive tensions and conflicts are minimized. Compliance training can be accomplished without excessively intruding upon the human-dog bond; in fact, when properly introduced, such training can produce a lasting beneficial effect on the relationship.

In addition to avoiding recommendations that may potentially harm the relationship between family and dog, training recommendations should not present risks of injury to the owner or dog. Although well-timed corrections can be highly effective and expedient, recommendations involving the hitting and hanging of aggressive dogs (Koehler, 1962; Hart and Hart, 1985a) should be avoided. Not only are such methods of questionable efficacy, they may actually significantly worsen the situation if improperly performed and, perhaps, cause the owner to be bitten or cause physical injuries to the dog.

In conclusion, both excessively intrusive and aversive techniques may adversely affect owner compliance or violate humane standards of practice. Cynopraxic trainers should make an effort to conform their training interventions to the LIMA (least intrusive and minimally aversive) principle by employing procedures that represent the least necessary intrusion upon the human-dog bond and

cause the dog a minimal amount of discomfort, as necessary to achieve the behavioral objective. Further, training recommendations should do no harm to the human-dog relationship, to the dog, or to the owner in the process of implementing them.

Rather than dictating a one-sided program that cannot be realistically implemented by the family, the cynopraxic counselor should work with the family in a spirit of teamwork to find a common solution. Toward achieving this aim, the counselor should listen to the family's needs and be creative. Just as it is certainly true of dogs, people are individuals possessing unique strengths and weaknesses that need to be recognized and integrated into the training plan. Good cynopraxic counselors know how to work well with both people and dogs.

Follow-up

The last step in the training process is follow-up. Follow-up assessment helps to further confirm or disconfirm the working hypothesis and the training plan, with respect to short- and long-term benefits. Typically, follow-up is neglected by busy trainer-counselors unless clients call for additional help—no news is good news. Mailing a brief follow-up questionnaire 6 months after the last session can be very useful in evaluating the lasting benefits of the intervention, as well as maintaining a good working relationship with clients. When possible, cases involving serious aggression should include a follow-up session after 3–6 months to detect and counter recidivist tendencies. Research efforts designed to evaluate the effectiveness of specific training interventions should always include an assessment of both short-term (3 to 6 months) and long-term (1 to 3 years) benefits.

Describing and Classifying Behavior Problems

Rational assessment and intervention require that a dog's behavior problem or disorder be described and classified in scientific terms. Canine behavior problems can be classified according to precipitating etiology, descriptive features, or function, that is, controlling antecedents and consequents. However, as Medawar [1967, quoted in Tinbergen (1974)] points out, "It is not informative to study variations of behaviour unless we know beforehand the norm from which the variants depart" (1967:109). To assess a dog's behavior properly, an ethogram of normal behavior is a necessary foundation. A dog ethogram is an orderly compilation of what a dog does. Table 2.2 does not pretend to be exhaustive in this regard but serves to provide an abbreviated catalog of significant functional systems and species-typical behavior patterns that are associated with most common behavior problems and disorders. The ethogram borrows from an earlier system devised by Scott (1950).

Significant controversy exists surrounding the notion of abnormal or dysfunctional behavior. Some behavioral practitioners (e.g., applied behavior analysts) eschew the notion of abnormal behavior, asserting that all behavior (normal or otherwise) is foremost a reflection of environmental contingencies (Burch, personal communication, 2000). If behavior appears abnormal, it is not because of some flaw or other cause lurking within the organism, but is the result of "abnormal" contingencies upon which the organism is forced to act and adjust. Many dog behavior consultants and therapists, however, do espouse the view that behavior itself may be abnormal to the extent that it has lost its adaptive function. According to this view, abnormal behavior is characteristically rigid and unresponsive to environmental contingencies, that is, it has lost its adaptive plasticity and efficiency. From a biological perspective, behavior may become abnormal when it is unable to achieve homeostatic equilibrium in response to internal or external stressors (Fraser, 1980). Others describe abnormal behavior in terms of maladaptive behavioral excesses and deficits in which species-typical actions appear under- or overresponsive to environmental stimuli. According to this viewpoint, the animal's abnormal behavior is the result of a complex constellation of adverse cognitive and motivational factors impeding its ability to function properly. Proponents of this perspective are apt to view abnormal behavior as stemming from the disruptive influences of anxiety and fear,

TABLE 2.2. Dog Ethogram

Category and Activity	Problems
Affiliative behavior: All behaviors involved in the formation and maintenance of the human-dog bond [e.g., separation distress, attention seeking, proximity seeking, contact seeking, following, cooperative behavior, social facilitation, staying close (going out and returning back to handler), and obedience to command].	*Excesses:* Overattachment, excessive separtion distress, demanding attention-seeking behavior. *Deficits:* Aloofness, uncooperative, independent.
Appetitive behavior: All patterns of foraging and ingestive activity (e.g., eating and drinking). Caching (burying food and toys).	*Excesses:* Obesity, pica, coprophagy, destructive behavior, digging, compulsion (licking, sucking, air snapping). *Deficits:* Anorexia.
Caregiving (epimeletic behavior): Licking, nursing (standing and laying), anogenital stimulation for elimination, scruff carrying, severing umbilical cord, discipline, regurgitation, protection.	*Excesses:* Pseudopregnancy, excessive care giving (grooming, licking). *Deficits:* Failure to groom, nurse, or otherwise care for young.
Care seeking (et-epimeletic behavior): Jumping up, mouth licking (regurgitation), attention seeking, whining and whimpering, begging, petting demands, pawing, hand and face licking (directed towards humans), submissive crawling up, nuzzling.	*Excesses:* Social instrusiveness, contact dependency, jumping up, begging, excessive attention seeking. *Deficits:* Withdrawn, disinterested, failure to bond.
Competitive ritualization (agonistic behavior): Agonistic pucker, alpha T, standing over, piloerection (hackles), pupillary constriction, stiff-leggedness, direct stare (sometimes with red glow), upright ears, tail cocked above the back line, standing over, pawing, mouthing, jumping up with threat, fang baring. Other behaviors under this heading include growling, snarling, biting (hard and inhibited), snapping, fang whacking, jaw punching, redirected attacks.	*Excesses:* Inappropriate dominance displays toward owner. Aggression in a variety of forms, especially involving attacks during competitive conflicts. Inappropriate reactions to physical control and restraint. *Deficits:* Overly inhibited, shy of contact, difficult to train.
Play: • Agonistic: Mouthing, biting clothing, jumping up • Predatory: Ball play, toy shaking, pouncing • Sexual: Mounting, riding up, pawing • Social: Chase and evade, play bow, tug lay • Solitary: Carrying toy, throwing toy, chase and pouncing, rolling, cynosoliloquy (self-play ritual).	*Excesses:* Uncontrollable or disruptive play involving provocative mouthing and biting, jumping up, and chase games. Excessive exploratory interest in environment, resulting in destructive behavior. *Deficits:* Absence of appropriate play behavior , curiosity and exploratory interest in the environment (*see Exploratory behavior*).
Predatory behavior: Hunting (sniffing, tracking, scanning), stalking, and predatory attack sequence (chasing, catching, shaking kill, choking kill, and other behavior aimed at securing and devouring prey).	*Excesses:* Attacking and killing other animals. *Deficits:* No interest in hunting or pursuing game (hunting dogs).

TABLE 2.2. Dog Ethogram—*continued*

Category and Activity	Problems
Resting and sleeping (shelter seeking): Sprawling, sleeping on back, bow and humpback stretch, curl rest, lateral recumbent, sphinx rest, yawning. Resting and sleeping include various shelter-seeking behaviors and efforts to secure a favorable place to rest (e.g., turning about several times before lying down).	*Excesses:* Sleeping problems, narcolepsy. *Deficits:* Unable to sleep through the night, pacing, vocalization.
Urine marking and identification: Raised-leg urination, squatting, over-marking, scratching.	*Excesses:* Urine marking in the house, excessive raised-leg marking on walks. *Deficits:* Unable to eliminate away from familiar odors, locations, and substrates.
Sexual behavior (courtship): Licking and sniffing ears, mouth, and genitals; mounting, harassing, pawing, riding up, female snapping, roaming, intermale aggression, scent marking, standing with tail averted to the side, intromission and tie.	*Excesses:* Sexual interest directed toward inanimate objects. Mounting exhibited toward humans. *Deficits:* Failure to engage in sexual behavior with conspecifics.
Elimination behavior: Various postures (squatting, standing, leg lifting), defecation, submissive urination, fear-induced defecation and anal release.	*Excesses:* Inappropriate elimination, excitment-submissive urination during greetings, separation-related elimination. *Deficits:* Inhibited eliminating in strange areas, constipation, urinary retention, interfering placement preferences.
Exploratory behavior: Sniffing, digging, chewing, scent rolling, vomeronasal response. Includes all investigative and inquisitive interactions directed toward the physical, biological, and social environment.	*Excesses:* Distractibility, scavenging, boredom-related excesses, searching trash bins, inappropriate social investigation toward humans. *Deficits:* Disinterest, depression (boredom), fear of novelty and unfamiliar situations, reduced play and curiosity.
Fearful behavior: Shaking, pupillary dilation, panting, salivation, urination, ears back, corners of the mouth retracted down and back, tail between the legs, running away, possible antecedent to aggression when escape blocked.	*Excesses:* Panic, phobias, generalized anxiety, psychosomatic disorders, social flight and avoidance. *Deficits:* Lack of appropriate fear (e.g., toward cars or electrical cords).
General motor activity: Walking, running, trotting, loping run, jumping, hopping, "observation jumping," crawling, stalking.	*Excesses:* Hyperactivity, motor stereotypies (whirling, fence running, pacing). *Deficits:* Hypoactivity (depression).
Greeting and departure rituals (active submission, *et-epimeletic):* Jumping-up, licking, tail wagging, wiggle-waggle display, spinning, play face, sniffing, bringing comfort item, excitement urination, moan howl.	*Excesses:* Intrusive behavior, jumping on guests, excitement urination, interfering with departures. *Deficits:* Disinterest at greetings/departures.

TABLE 2.2. Dog Ethogram—*continued*

Category and Activity	Problems
Packing behavior (allelomimetic): Running together, group defense, rallying around the owner, leader-follower behavior, social-facilitated eating and various other forms of "contagious" behavior.	*Excesses:* Proximity and contact-seeking behavior, overprotective of the group. *Deficits:* Failure to develop appropriate following behavior, aloof, disinterested in coordinated activity (*see Affiliative behavior*).
Submissive ritualization (active): Jumping up (greeting behavior), licking, tail wagging, rubbing against, grabbing with muzzle (see *Care-seeking (et-epimeletic behavior* and *Greeting and departure rituals*).	*Excesses:* Overly submissive and fearful toward people. *Deficits:* Inability to defer to owner or show appropriate appeasement gestures to other dogs.
Submissive ritualization (passive): Licking, lowering of body, averting eye contact, ears back, submissive pucker (corner of mouth), grinning (baring front teeth), lateral recumbency, exposure of inguinal area, yelp, nuzzling, crawling, tail low or between the legs.	*Excesses:* Excessive greeting behavior, obnoxious submission, attention-seeking compulsions. *Deficits:* Reduced social interaction, reserved, distant.
Territorial behavior: Barking, threat and attack, scent marking.	*Excesses:* Threatening and attacking guests and passersby, aggressive toward other dogs, fence fighting, excessive barking. *Deficits:* Lacks normal protective response, reduced alarm barking.
Vocalization: Barking, whining, howling, mewing, "purring," moaning, shrieking, squealing, whimpering, yowling.	*Excesses:* Barking at minimum provocation, barking to control attention, barking and howling at separation. *Deficits:* Mute.

frustration, and irritability. In contrast to the behavior analytical approach, practitioners embracing the cognitive-motivational perspective view the source of dysfunction to reside both within the organism itself and the environment. Finally, some forms of abnormal behavior are clearly the result of pathological conditions operating within the organism (e.g., nervous pointer dogs). Generally, the position held throughout this text is eclectic, combining the strengths of the above orientations as appropriate for pragmatic explanatory purposes. Emphasis, however, is placed on the disruptive influences of unpredictable and uncontrollable environmental conditions on the etiology of dysfunctional or maladaptive behavior.

Adverse environmental conditions exert a disruptive and disorganizing influence on behavior in several ways. First, a routine lack of environmental predictability and controllability is believed to be a significant source of anxiety, frustration, and depression (helplessness). Second, unpredictable and uncontrollable environmental conditions may precipitate persistent and problematic conflict, irritability, and stress, thereby impeding the dog's ability to adapt successfully, perhaps, continuing to exert an adverse influence even after environmental conditions are normalized (autokinesis). Third, a lack of consistent, predictable, and controllable interaction between the owner and dog promotes distrust and exerts a damaging influence on the bonding process.

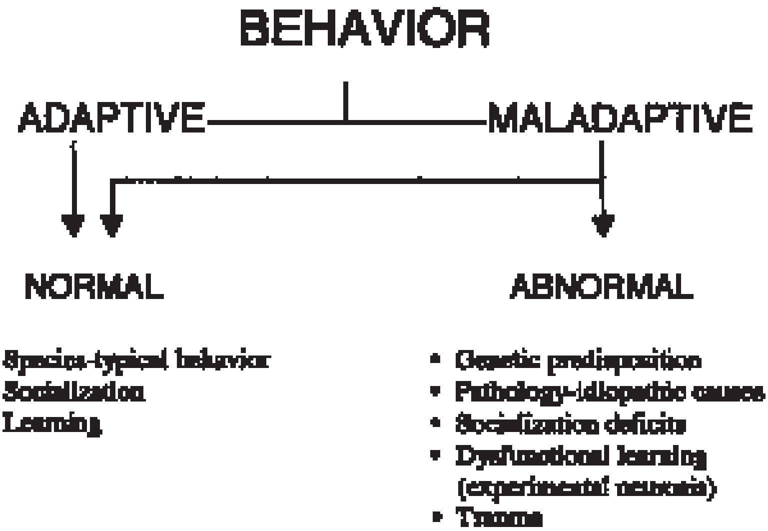

FIG. 2.7. Behavior is broadly categorized as being adaptive or maladaptive. Maladaptive behavior can be either normal or abnormal, depending on its etiology.

Behavioral Diagnostics and Classification

Behavioral diagnostics and the classification of behavior problems involves placing the results of descriptive and functional assessment into the context of specific diagnostic categories. In some cases, classification entails identifying an ethological functional system (or systems) that is adversely affected and expressed in a disorganized, dysfunctional, or maladaptive way (Figure 2.7). This process is impeded by the lack of a uniform and standardized system for classifying dog behavior problems, an especially problematic situation in the case of aggression- and separation-related problems. Some strides have been made toward formalizing such a classification system (Borchelt and Voith, 1981; Odendaal, 1997) but much remains to be done in this critical area.

The functional analysis and classification of behavior problems as diagnostic entities can provide a valuable frame of reference and functional link to relevant intervention strategies and working hypotheses. Behavioral diagnostics can also help one to form reasonable prognostic expectations about treatment outcomes. Despite these potential benefits, caution should be exercised to avoid the intrusion of anthropomorphism and the language of human psychodiagnostics when classifying dog behavior problems. Superficially, it may help an owner to possess an authoritative-sounding name to refer to his or her dog's behavior problem, but paraphrasing Kierkegaard's words, "To label me is to negate me." *Naming* is a *framing* process, and the act of naming may consequently place the behavioral specifics into a misleading etiological context, thereby potentially impeding effective treatment. Counselors should take extreme care when applying diagnostic terms to dog behavior complaints and to avoid terms possessing vague or anthropomorphic associations borrowed from the lexicon of human psychiatry. In addition to mislabeling and confusion, some diagnoses carry a stigma or connotation that can be very problematic and counterproductive with respect to treatment activities. For example, the label of *dominance aggression* may result in a greater risk that the dog will be euthanized rather than treated, simply because there is no reliable or permanent cure for the problem—an especially sad outcome since no one seems to agree on what is meant by the term *dominance* or how it causes a dog to become aggressive (see Chapter 8). Finally, naming and classifying behavior problems as

diagnostic entities may generate the illusion that the behaviors in question are better known or understood than is actually the case. This can be a serious source of confusion. Not only do the causes of many behavior problems remain to be elucidated, most of the behavioral protocols commonly used to treat them have not been scientifically tested or validated.

COMMON ETIOLOGICAL FACTORS UNDERLYING BEHAVIOR PROBLEMS

Biological and Physiological Factors

Many behavior problems surface as the result of underlying disease processes (Parker, 1990; Reisner, 1991). Abrupt mood changes, including heightened irritability and despondency, disorientation, and loss of appetite are possible symptoms of physical disease and should be reported to a veterinarian. Discomfort and physical pain are often associated with depressed affect, increased irritability, and aggressive behavior. Chronic ear infections, hip osteoarthritis, dental conditions, a variety of physical injuries, hypothyroidism, and a great many other medical conditions have been associated with aggressive behavior. It is of great importance, therefore, that a veterinary examination be performed as part of the diagnostic evaluation of unusual or acute displays of aggression. Normal hormonal influences may facilitate the expression of some undesirable sexually dimorphic behavior patterns, such as household micturition, mounting, roaming, and intermale aggression. Elimination problems involving inexplicable loss of control, increased frequency, or "leaking" may indicate the existence of a hormonal imbalance or disease rather than a failure to learn. Under the influence of persistent stress and anxiety, various pathological changes involving the hypothalamic-pituitary-adrenocortical (HPA) system may occur (see *Fear and Biological Stress* in Volume 1, Chapter 3). Besides the release of corticoid hormones, stressful stimulation of the adrenal cortex also stimulates the release of sex hormones. Under chronic anxiety and other stressful conditions, the adrenal glands may become enlarged (adrenal hypertrophy), producing excessive amounts of these various hormones, perhaps contributing to increased irritability and heightened aggressive tendencies. Bizarre atypical behavior and seizures are often symptomatic of neurological conditions. Severe parasitic infestations have been associated with the development of many behavior problems ranging from heightened irritability to destructiveness. Coprophagia may be associated with advanced pancreatic disease and various nutritional disorders, such as thiamine and other vitamin-B-complex deficiencies. Hyperactivity may result from neurological impairment. Occasionally, the failure of a dog to learn may be due to sensory deficits such as deafness, especially in breeds prone to such ailments. Interestingly, Chapman and Voith (1990) have found little support for the opinion that behavior problems in geriatric dogs are primarily attributable to physical conditions. Geriatric behavior problems are often new and unrelated to previous problems. They found no correlation between a lack of early "appropriate training" and the development of behavior problems in older dogs. Since organic disease may reflect itself in behavioral changes, it is imperative in cases involving severe or unusual behavior problems that appropriate diagnostic testing and thorough veterinary examination precede the initiation of behavioral assessment and training.

A biological factor of considerable importance is genetic predisposition (see *Genetic Predisposition and Temperament* in Volume 1, Chapter 5). Although biological predisposition may incline some dogs to develop abnormal behavior (e.g., nervous pointers), most behavior adjustment problems are a composite of nature (biology) and nurture (experience) influences. So-called clinically abnormal dogs that are unresponsive to training and other management strategies are rather rare. Both normal and abnormal behavior develop within a biological and environmental context. Some severe behavior problems are under a powerful biological influence, which may prove very difficult to control through behavioral means alone. Although these behavior problems may not be fully cured, nearly all of them can be controlled by appropriate behavior modification, training, and appropriate veterinary support. The critical factor is client commitment and compliance.

Dysfunctional Social and Environmental Influences

Although biology most certainly plays a significant role in the development of normal and abnormal behavior, the vast majority of behavior adjustment problems are social (human-dog relationship) problems or environmental (home adaptation) problems. In addition to the predisposing influences of biology, behavior problems develop under the influence of numerous contributory factors, such as environmental stressors, unpredictable and uncontrollable aversive or attractive events, sensory and physiological privations (e.g., boredom and excessive confinement), socialization and environment-exposure deficits, and mistreatment. Under the influence of such adverse conditions, adjustment anomalies can hardly be described as pathological or abnormal. Such dysfunctional behavior, presenting under the influence of destructive or disorganized antecedents and consequences, would be better characterized as normal behavior operating under abnormal or dysfunctional conditions. In short, disorganized contingencies of reinforcement and punishment result in disorganized and dysfunctional behavior.

Most behavior problems respond exceedingly well to cynopraxic and behavioral intervention alone. Such intervention frames and organizes the problem situation so that disorganized antecedents and consequences are reorganized in a way that results in the development of more effective and adaptive behavior. Consequently, unwanted behavior is either modified or replaced with more acceptable behavior.

Deprivation and Trauma

Early socialization and environmental exposure play important roles in the development and mastery of basic social skills, confidence, and health. Inadequate access to experience of this kind or emotional trauma occurring during these early sensitive weeks may lead to the precipitation of persistent emotional effects and behavior deficits. Puppies are most prone to develop phobic reactions early in life, especially during the period running roughly between 8 and 10 weeks of age (see *Learning and Trainability* in Volume 1, Chapter 3). Puppies exposed to intense startle or trauma during this sensitive period for the acquisition of conditioned fear are at risk of developing lifelong phobias. For example, a single bee sting may have far-reaching impacts on an adult dog's comfort and quality of life. Puppies commonly play with bees, some even catching and eating them, apparently oblivious to their prey's painful objections. Yet, under the right conditions (e.g., the stress of being left alone), a puppy who is stung in an especially sensitive area may develop a pronounced fear of bees that is easily generalized to the fluttering sounds and movements of other flying insects as well, perhaps, in addition, precipitating a pattern of excessive worry and anxiety when left alone. Such fear can be emotionally crippling and detrimental to the dog's future as a working dog or companion, with the generalized fear of insects becoming an almost constant source of fearful discomfort, sympathetic arousal, and anxious vigilance during spring and summer months.

Such naturally occurring traumatic events are hard to entirely guard against, but many of the traumas that produce lasting negative behavioral effects are preventable. Just as many children are abused with physical punishment, puppies are often subjected to brutal punitive actions by the hand of angry owners. Crushing beatings followed by long hours of isolation in the name of behavioral control are not only cruel but totally unjustifiable. Dogs exposed to such treatment may present behavioral signs indicative of post-traumatic stress disorder (PTSD) and learned helplessness (LH), but some dogs, even despite the most abusive treatment, are extraordinarily resilient and may not show any significant signs of detriment as the result of abuse (Fisher, 1955). Temperament appears to play a significant protective or facilitatory role in the expression of disturbed behavior (see *Learning and Behavioral Disturbances* in Volume 1, Chapter 9). Behavioral signs of PTSD and LH include increased irritability and reactivity, anxious vigilance (increased sensitivity to startle), irrational fearful reactions, explosive-impulsive behavior (aggression occurring

under minimal provocation), hypoactivity or hyperactivity, social withdrawal and avoidance, depressed mood, decreased motivation, learning and training deficits, and lack of normal responsiveness to routine discipline. These symptoms often worsen with the passage of time, with affected dogs appearing hyperactive and distracted but at the same time remaining socially withdrawn and insular. Some dogs may exhibit exaggerated and compulsive efforts to make physical contact but overshoot the mark and fail to obtain what they appear to so desperately need. Consequently, even though they may be socially demanding and demonstrative, their efforts never connect with their owners in a satisfying way. Paradoxically, such intrusive excesses appear to reflect a dysfunctional coping mechanism designed to maintain social distance and avoidance rather than to maximize social contact and comfort.

Social isolation and sensory deprivation have been frequently implicated in the development of various emotional and cognitive disorders (Scott and Fuller, 1965). Many dogs spend long dreary days and nights locked in basements or confined to empty crates. Under such conditions, dogs may be stressed and inclined to develop a variety of behavior problems. Further, crate confinement is often used to control dogs that are the most incompatible with restraint by crating. For active and curious young dogs, crate confinement may produce significant frustration and distress, leading to compensatory excesses when they are released. In such cases, the crate provides a hub for a daily round of frustration and distress, followed by heightened excitability and hyperactivity, leading to punishment and more confinement, isolation, and so on. Long periods of solitary confinement to an unsocialized part of the house (e.g., in the basement or garage) should be avoided. As a rule, if a dog needs to be crated, it should be done in a part of the house where it normally spends time with people when not confined, usually the kitchen or bedroom. In addition, dogs that by necessity must be routinely left alone for long periods should be provided with a dog companion. Clark and colleagues (1997) reported that although the provision of out-of-cage exercise had little effect on immune function and cortisol measures of stress, behavioral measures indicated that single housing may adversely affect canine well-being. Finally, single housing may promote nonsocial repetitive behavior (e.g., pacing and circling) and sustained efforts to increase sensory input, perhaps in an effort to stave off boredom (Hubrecht et al, 1992).

Although a crate can be a useful training tool, it is too often used as an alternative to proper training and may become a way of life for problem dogs—a steel straitjacket! The use of crate confinement should always signify that some active and purposeful training is being accomplished by its implementation and, further, a plan is in place to ensure that the dog is eventually released from such close quarters—a philosophy of crate confinement referred to as *constructive confinement.* Admittedly, some dogs appear to adjust well to life in a crate, and, in other cases, it is justified as a means to control an ongoing behavior problem, especially in cases involving destructive behavior or house-training difficulties. In such cases, it may be necessary to confine the dog by crating to prevent injury or damage to household belongings. In general, though, a crate should not be used in a cavalier manner or employed for everyday confinement without good reason.

Dogs need daily attention. They thrive on the variety and stimulation provided by social contact, long walks, and structured activities like obedience training and ball play. Dogs are first and foremost social animals whose primary identity is experienced in their immediate social relations and cooperative activities. If they need to be left alone for long periods during the day, then efforts should be made to ensure that they obtain sufficient social attention, exercise, and environmental stimulation when the family returns home from school or work. Unfortunately, this rather obvious obligation is often forgotten in the busy modern family, and the dog's needs are neglected. This passive neglect can exert a very destructive effect on a dog's behavior and cause it to become marginalized over time. The combination of crate confinement and neglect may adversely affect the bond between the owner and the dog. Patronek and colleagues (1996) found that dogs confined to

crates were at an increased risk of relinquishment to animal shelters:

> Dogs that spent most of the day in the yard or in a crate were at an increased risk for relinquishment. Because of the retrospective nature of this study, it was not possible to determine whether dogs were relegated to the yard or a crate as a result of behavioral problems or whether keeping dogs in these situations resulted in isolation from the family, less attachment, and less training, thereby increasing the risk of relinquishment. Because crates are commonly recommended to the novice dog owner as a training or behavior management device, determining whether crates are being use appropriately in specific situations is important. (579)

In approximately a third of cases in which dogs were relinquished, owners commented that keeping a dog was much more work than they had expected. Other significant risk factors identified by the study include

- Failure to participate in obedience classes after acquisition
- Lack of routine veterinary care
- Sexually intact status
- Inappropriate care expectations
- Dogs obtained from a shelter
- Dogs acquired after 6 months of age

Interestingly, with respect to dogs with behavior problems, getting good advice appears to make a big difference. Owners who received helpful advice were 94% less likely to give up their dogs than were owners who had received bad advice. The study should give one pause to consider the potential consequences of recommendations, knowing that bad advice may have life-threatening implications.

Excessive Indulgence

Just as neglect and isolation may exert an adverse influence, excessive or inappropriate contact and indulgence can also contribute to the development of maladaptive behavior. Although the role of anthropomorphic attitudes and spoiling activities in the etiology of behavior problems is controversial (Voith et al., 1992; O'Farrell, 1995; Jagoe and Serpell, 1996), given the robust effects of learning and socialization on behavior, it is reasonable to assume that noncontingent reinforcement (spoiling) and dependency-enhancing activities (pampering) would lead to some problematical long-term cognitive and behavioral effects. In fact, Vilmos Csányi and colleagues (Topál et al., 1997; Douglas, 2000), at Eötvos Lóránd University in Budapest, have reported evidence suggesting that heightened social dependency may impede a dog's ability to function independently, thereby impairing its problem-solving abilities. They found that anthropomorphic attitudes as measured by questionnaires were highly correlated with a dog's relative success at solving problems without help. When performing a simple problem-solving test, dogs most closely bonded with their owners tended to perform worse than dogs having a less intimate bond. Although moderate amounts of spoiling and pampering are probably not detrimental, excessive dependency-enhancing interaction may adversely affect a puppy's development, perhaps facilitating the development of certain behavioral deficiencies and problems. Overly dependent dogs appear to fixate developmentally and remain "perpetual puppies": they may fail to develop adultlike attentional and impulse control abilities, lack appropriate skills (e.g., delay of gratification) needed to cope with frustrative situations, respond maladaptively to anxious arousal, and, finally, are often prone to exhibit disruptive separation-related behavior when left alone. Since overly indulgent owners may fail to address assertive or threatening behavior properly, these incipient signs of developing aggression may be allowed to develop into a more serious and intractable problem.

Unfortunately, the dearth and quality of relevant research makes it difficult to make any hard and fast statements about the role of rearing practices on the development of behavior problems; however, it is reasonable to assume that excessive indulgence (spoiling and pampering) does exert some adverse influence on development and should be avoided. One is inclined to conclude that indulgent excesses in the direction of social permissiveness, on the one hand, and excessive dependency-enhancing activities, on the other, may contribute to the development of dominance- and separation-related problems in susceptible dogs—problems that tend to

appear as they reach adulthood. Although indulgent and permissive rearing practices may not represent the *sufficient conditions* under which serious behavior problems develop, such practices may represent significant *necessary conditions* influencing the incubation and expression of such problems in genetically predisposed dogs. Further, given that such problems do occur, a history of permissiveness may make such problems more difficult to manage or control through behavioral means. Conversely, the presence of good rearing practices may be *necessary* for the development of well-adjusted dogs, but good rearing practices alone may not be *sufficient* to prevent the development of a serious behavior problem. In addition to avoiding indulgent excesses, the owner should be encouraged to incorporate sound rearing practices, including integrated compliance training, handling and desensitization activities (e.g., massage), and exposing the puppy to varied environments involving different people and other dogs.

Inappropriate Play and Bootleg Reinforcement

Many behavior problems can be traced to inappropriate play. Permissiveness toward undesirable puppy excesses like mouthing, jumping up, and teasing displays often lead to persistent problems later. Although there appears to exist a significant independence between aggressive play (e.g., tug games) and serious aggression (Podberscek and Serpell, 1997; Goodloe and Borchelt, 1998), excessive and aggressive tug-of-war and chase games may inadvertently elevate a puppy's relative competitiveness, increase its aggressive readiness, and gradually cultivate its confidence to act out aggressively toward humans (Netto et al., 1992). Hard agitational tug games not only develop aggressive readiness and confidence, they also encourage puppies to bite hard and to struggle with a human opponent. Puppies being raised for bite work as police or military working dogs are routinely agitated with rag play, thereby promoting aggression that is gradually and systematically shaped through various stages into a full attack response. Essentially, such efforts are designed to facilitate aggression toward people through the confidence-building safety of play.

Despite the risk associated with excesses, not all competitive play should be discouraged, however. Structured and pacifying tug games can perform a useful role in the control of playful aggression, the promotion of bite inhibition, and control over aggressive impulses. To make such play constructive and avoid untoward side effects, the owner should always initiate play, control the direction and intensity of play, and teach the puppy to release the tug object (usually a ball with length of rope) on command, thereby promoting impulse control and deference. Once the object is released, the competitive phase of the play is concluded and is immediately followed by the cooperative phase of the game. The cooperative phase consists of tossing the ball a short distance and encouraging the dog to return with it. The owner either proceeds to initiate additional tug activity or trades a piece of food for the ball. Signs of excessive aggressive effort or unwillingness to release the toy should be appropriately discouraged.

Chase games are also notorious for establishing competitive interaction and serving as a staging ground for more serious problems later. Problems deriving from chase-and-catch games often begin innocently as part of routine play in which the owner chases the puppy while the latter has a toy. Gradually, the innovative puppy discovers that its owner becomes even more excited and "fun" when a sock or stocking is lifted. In time, the puppy discovers that it can outrun its exasperated owner. Perhaps, under the facilitative influence of rag play and other competitive activities that give the puppy permission to bite, combined with species-typical defensive mechanisms, the puppy may at some point growl or snap. This is especially likely to occur from behind a piece of furniture or other similar situations producing a feeling of entrapment. Both agitational tug and chase games tend to increase competitiveness and narrow relative dominance between puppies and owners. It is important to remember in all cases involving competition: *only near equals compete.* Excessive or unstructured competitive play may blur important social

boundaries and set into action a chain of events and lasting effects that may predispose puppies to exhibit more problematical behavior as adults. For example, dogs exposed to excessive chase interaction may prove very difficult to train to come when called, and dogs whose primary interaction with humans is playful may not appropriately limit social excesses when required to do so.

Early learning strongly impacts on how puppies will behave as adults. Many behaviors that are considered cute tend to be perpetuated and may take on unwanted dimensions as a dog matures. Puppies are often allowed to bark manipulatively or to jump on countertops while their owners are preparing food. Although such behavior may initially present itself as an affirmation of a puppy's good appetite and enthusiasm, the owner often realizes too late how much a nuisance such demanding behavior can be in adult dogs. Occasionally, an owner (or children) may pity the soulful drooping eyes and beckoning drool of a begging puppy at dinnertime, only to establish a persistent habit and nuisance.

Often owners are actually very diligent to reward only desirable behavior and to punish undesirable behavior, but problems still arise in spite of their best efforts. Many factors could be at work in such cases, but inadvertent reinforcement should be considered first. Frequently, a consequence that an owner believes to be aversive is not actually punitive for a puppy or dog. This is also the case with many ostensible rewards that fail to strengthen behavior; simply because we think a puppy or dog should like something does not necessarily mean that it will. Most puppies appear to enjoy petting and praise, but they may not be very willing to work hard for it as a reward. To some extent, the value of petting and praise as a reward may stem from its being paired with the emotional relief produced by the termination of an aversive event (negative reinforcement) or with reassurance that the avoided event is not forthcoming. Romba (1984) has suggested that the primary benefit of petting and praise during avoidance training is to reduce fear and anxiety associated with the process. Although social rewards can be effectively used as positive reinforcers in their own right (see *Motivation, Learning, and Performance* in Volume 1, Chapter 7), their reliability is enhanced when they are presented in conjunction with tangible rewards, such as food and play. Finally, dogs appear to respond innately to high, repeated tones as attractive sounds and tend to become excited by their presentation, whereas abrupt or drawn-out guttural sounds may be perceived as threatening signals, causing behavioral inhibition (see *Sensory Preparedness* in Volume 1, Chapter 5). As a result, repeated high tones (praise) may be biologically prepared for association with rewarding events, whereas abrupt (reprimand) or low drawn-out (warning) tones may be preferentially associated with punitive outcomes. Properly manipulated, tonal variations of voice can be used very effectively in the control of behavior.

Punitive events can be especially problematic. A puppy's social behavior is driven by two complementary motivations: competition and affiliation. The social impact of these motivational variables is simultaneously to distance the puppy while at the same time enhancing its need for social contact. Most attention-seeking behavior appears to be related to active submission. Because of the motivational connection between attention-seeking and active submission, punishment of excessive attention-seeking behavior may actually frustratingly amplify it, especially if it falls short of evoking passive submission. The synchronic dynamics of attraction and repulsion are consistent with adaptations needed in order to maintain a stable pack organization, where a dominance hierarchy stratifies social relations (a distancing factor) but at the same time minimizes the risk of social disintegration (attraction factor). Problems arise when these variables are present in unbalanced proportions. A puppy driven by excessive dominance testing is independent and prone to develop behavior patterns that threaten social cohesion (the owner rejects it). On the other hand, the attention seeker (actively submissive) is often overly dependent, hyperactive, and prone to become excessively attached and cope poorly when left alone.

A puppy's reliance on attention seeking (active-submission behavior) and dominance

testing (competitive interaction) is precisely what it is biologically inclined to do in order to maximize its survival and success in a pack community. Many puppies come into the home with an established social status—hard earned and often vigorously defended. Such *dominant* puppies respond to their owners *provocative* discipline efforts as challenges and react competitively, sometimes exhibiting precocious aggressive reactions together with hard biting. It is very easy for a puppy to slip into a faulty perception of the owner's intentions during punitive interaction. When discipline fails to reach a sufficient threshold, it may be interpreted as a weak challenge by the dominant puppy and countered with oppositional defiance. Other puppies appear to confuse the owner's inadequate disciplinary efforts as an invitation to play and compete. The edge of discipline may be so blunt and ineffectual that puppies may misinterpret its intended meaning. Care must be taken to guard against such frustrating and counterproductive interaction. Such puppies are most effectively managed with a combination of time-outs and instrumental counterconditioning.

Another source of unintentional maintenance of undesirable behavior involves intermittent reinforcement. Many behavior problems are supported by an intermittent schedule of reinforcement occurring concurrently with other training efforts being applied to suppress the unwanted behavior. This is a very common situation, possibly perpetuating a continuous cycle of unnecessary and escalating punishment. For example, most owners of large dogs recognize the need to train them not to jump up. For the most part, such training efforts are carried out conscientiously by owners, but, on some special occasions of affectionate significance, an owner may allow the dog just one exception to the rule. As is the case with any disconfirmed generalization (behavioral or otherwise), the counterexample defines the rule or, at least, undermines the intended rule. Further, if a dog has a strong inclination to jump up, such periodic reinforcement will progressively make it more difficult to extinguish fully. Such dogs are often intermittently reinforced for jumping up by well-meaning but misguided guests who actually encourage and evoke such behavior, leading the dogs to experiment on guests not so inviting of bad canine manners.

Finally, inadvertent or bootleg reinforcement is a frequent problem in family situations where differences of opinion exist regarding an unwanted behavior. For instance, one family member may feel strongly that the dog should not be allowed on furniture while other members enjoy such behavior and allow it in the objector's absence. Occasionally, a dog's behavior becomes a serious source of family tension and disagreement, with the dog suffering inconsistent and abusive treatment. Training requires a united front with a shared sense of purpose and agreement on the behavior being modified. It is for this reason (and many others) that counseling and training are best carried out in the context of the home in the presence of the entire family whenever possible. Behavior counselors should establish a consensus among family members before training proceeds.

CONTROL AND MANAGEMENT OF BEHAVIOR PROBLEMS VERSUS *CURE*

Behavior problems cannot always be cured, but most can be effectively managed and controlled by applying appropriate behavior modification and training efforts. Although the vast majority of behavior problems are responsive to treatment, some problems are *untreatable.* For example, dogs that occasionally bite guests or children without giving recognizable warning signals beforehand pose many difficulties. Such behavior problems are designated untreatable because the results of behavior modification cannot be adequately tested and evaluated without exposing some person to the potential danger of being bitten. Although dogs exhibiting such problems may be managed through careful handling and preventive restraint measures, the absence of other relevant behavior (e.g., threats) with which to infer a dog's level of aggressive arousal and likelihood of attack precludes the possibility of making reliable judgments about the relative effectiveness of treatment efforts.

One is left only with the absence of aggressive episodes or reduced magnitude of aggression (behavior that may still do significant damage) to judge progress. In both cases, assessment of treatment success depends on exposing the dog to potential victims (without possessing a reliable indicator of attack likelihood) and assessing success by the absence of attack during such potentially aggressive contacts. Obviously, the mere absence of aggressive behavior is not an adequate assessment measure (see *Dead-dog Rule*) and should not be used in isolation to evaluate the benefit of training efforts or to predict the future likelihood of attacks. Therapeutic benefit is objectively assessed by the presence of prosocial behavior correlated with safety from aggression. In the case of aggression problems designated as *treatable,* past episodes of aggression present on a highly predictable basis and are regularly preceded by recognizable threat displays or other clear signs of impending attack. Progress in such cases can be more safely inferred by the reduction of active threat displays, by an increase of incompatible affiliative behavior, or other behavioral changes indicating reduced aggressive arousal and a decreased probability of attack.

Most behavior problems can be controlled or managed through a variety of interventions (e.g., training, exercise, nutrition, or medication), environmental alterations, and the manipulation of antecedent variables and reinforcement contingencies controlling the unwanted behavior. Although behavior problems are highly responsive to training, they should not be construed as *curable* in the same sense as an infection might be cured by an antibiotic. Further, behavioral change obtained through behavior modification is reliably maintained only as long as the critical control and management efforts are maintained. Perhaps the greatest obstacle to success is too much improvement occurring too early and rapidly in the training process—a circumstance that may cause the client to become overly complacent and toy with disaster. While there is a strong temptation for both the counselor and client to prematurely congratulate each other on their achievements, it is incumbent upon responsible dog behavior consultants to remind their clients that problems (especially those involving aggression or fear) demand lifelong vigilance and commitment. There are no miracles or magic cures.

The counselor's goal is to educate clients, assess and place the behavior problem into an objective framework, instruct clients in appropriate management and training techniques, establish realistic expectations, and *do no harm.* These general considerations are particularly important when evaluating and making recommendations regarding serious aggression problems. Behavioral counseling and training may help to reduce the likelihood of aggression in the future, but clients should never be misled into believing that their dog's aggression problem can be cured by behavior modification. Although such dogs may never bite again after training, their status remains indeterminate and their recovery a lifelong process of careful management and training. Aggression problems are never cured—even if they are cured!

PART 2: EVALUATION FORMS

CLIENT WORKSHEET

Client Information

Name:

Address:

Phone: H ( ) W ( ) Fax ( )

Appointment: Date / / Time: :

Veterinarian: Ph ( )

Directions:

Signalment

Name: Breed/Mix: Age:

Sex M ❑ F ❑ Status: Intact ❑ Spayed ❑ Neutered ❑

Other:

Interviews

Telephone:

Home:

DOG BEHAVIOR QUESTIONNAIRE

Date: / /

Client Information

Name:

Address:

Phone: H ( ) W ( ) Fax ( )

Appointment: Date / / Time: :

Veterinarian: Ph ( )

Directions:

Dog Information

Name: Breed/Mix: Age:

Sex M ❑ F ❑ Status: Intact ❑ Spayed ❑ Neutered ❑

Age when altered:

Did you notice any short- or long-term changes in your dog's behavior after altering?
Was your dog altered because of a behavior problem? If yes, explain:

Are your dog's vaccinations up to date? Yes ❑ No ❑

Does your dog have any medical conditions? Yes ❑ No ❑
If, yes, please explain?

Is your dog currently given any medications? Yes ❑ No ❑
If, yes, what medications?

Please answer the following questions. All information that you provide is confidential. It is important to answer carefully since the information will be used to help assess your dog's behavior. Please add any additional information as you see fit. If a particular question is not relevant to your dog, mark it N/A.

▶Section 1

How old was your dog when you acquired it?

Has the dog had previous owners? If yes, explain:

Where did you get your dog? Breeder ❑ Pet store ❑ Animal shelter ❑ Friend ❑ Other ❑

How does your dog spend the majority of its time?

Where is your dog kept outdoors?

How often is your dog exercised?

How long? More than... 10 minutes ❑ 45 minutes ❑ 1 hour ❑ 2 hours ❑

Briefly describe your dog's daily exercise routine:

When is your dog fed? AM ❑ PM ❑ Both ❑

What do you feed your dog? Canned ❑ Dry ❑ Table Scraps ❑ Treats ❑

Describe your dog's feeding habits? Finicky ❑ Good appetite ❑ Voracious ❑

What are your dog's favorite toys?

What sort of play does your dog enjoy most? Ball play ❑ Chase games ❑ Tug ❑ Other ❑

Where does your dog sleep? Bedroom ❑ Kennel ❑ Kitchen ❑ Other ❑

▶Section 2

Please describe the general social layout of the family (e.g., children, other adults, and animals) and the dog's place in it?

Has your household changed since acquiring your dog? Yes ❑ No ❑

If yes, please describe:

Does your dog enjoy children: If not, please explain:

Please describe your dog's interaction with other animals in the household:

Describe how your dog reacts to guests and strangers:

Describe your dog's behavior around other dogs:

▶Section 3

Why did you decide to acquire a dog? Companion ❑ For child ❑ Protection ❑

Describe your dog's behavior as a puppy. Anything unusual?

Why did you choose the breed?

Have you owned other dogs in the past?

▶Section 4

Describe your dog's reaction to being left alone?

Describe your dog's behavior when you return home:

Do you use a crate? If yes, when did you begin to crate your dog?

How many hours a day is your dog kept in the crate?

Less than... 5 hours ❑ 10 hours ❑ 15 hours ❑

▸Section 5

Has your dog ever been to obedience school? Private ❑ Group ❑

How many weeks of training?

What training school or professional trainer/behaviorist did you use?

What training methods or philosophy did the trainer emphasize?

Briefly describe your impressions and benefits from training?

Does your dog come when called?

Will your dog lie down on command?

Does your dog pull when being walked?

Please describe your dog's general attitude and response to obedience training:

▸Section 6

What do you consider to be your dog's most undesirable behavior?

When did you first notice the problem?

Rank the severity of the dog's problem: Mild ❑ Moderate ❑ Severe ❑

How often does the problem occur? Frequently ❑ Occasionally ❑ Rarely ❑

Has there been a recent change in frequency or severity? Yes ❑ No ❑

Have there been any changes in the household that could help to explain the appearance of the problem?

What have you done so far to correct your dog's behavior problem?

Why do you think the dog is exhibiting the behavior problem?

▶Section 7

Does your dog exhibit any of the following behavior problems? *(Please circle relevant behaviors and check approximate frequency.)*

	Never	Occasionally	Often
• House soiling (urination, defecation, marking, submissive urination):	❑	❑	❑
• Excessive barking or howling:	❑	❑	❑
• Coprophagia (stool eating, other animal's feces):	❑	❑	❑
• Destructiveness (scratching, chewing, digging):	❑	❑	❑
• Jumping up (on guests or owners):	❑	❑	❑
• Mouthing on hands or clothing:	❑	❑	❑
• Chases (cars, people, other dogs):	❑	❑	❑
• Object and food stealing:	❑	❑	❑
Does the dog attempt to run away when caught?		Yes ❑	No ❑
• Dominance testing (pushy behavior):	❑	❑	❑
• Sexual behaviors (thrusting against humans, inanimate objects, roaming):	❑	❑	❑
• Compulsive habits (paw licking, flank sucking, cloth sucking, whirling, other):	❑	❑	❑
• Overly submissive behavior:	❑	❑	❑
• Fearfulness (shy or phobic reactions):	❑	❑	❑
• Excessive excitability and impulse-control deficits:	❑	❑	❑
• Sleep problems:	❑	❑	❑

Any problems not listed?

1.

2.

3.

▶Section 8

Does your dog threaten or exhibit aggression toward family members? Yes ❑ No ❑

Describe all episodes of aggression (including threats) toward family members:

Does your dog ever react aggressively to grooming and other handling efforts? (e.g., lifting, moving off furniture)? Yes ❑ No ❑

Does your dog ever growl while being petted or hugged? Yes ❑ No ❑

Is your dog aggressive toward nonfamily members? Yes ❑ No ❑

If yes, please describe all episodes.

Describe your dog's reaction (growls, glares, bares teeth, snaps, barks, bites) under the following conditions:

	Never	Occasionally	Often
• When eating:	❑	❑	❑
• When playing:	❑	❑	❑
• When chewing on a toy:	❑	❑	❑
• When approached while sleeping:	❑	❑	❑
• When punished:	❑	❑	❑
• When people visit:	❑	❑	❑
• When visitors enter yard:	❑	❑	❑
• When reached for or touched:	❑	❑	❑
• While being put into crate:	❑	❑	❑

Explain:

How old was your dog when it exhibited the first signs of aggressiveness?

Is there anyone who the dog is never aggressive toward?

Does your dog suffer from any physical condition that might explain its aggressiveness?

Is your dog more aggressive toward males or females?

Has your dog ever killed any animals?

Does your dog show signs of fear prior to becoming aggressive?

Describe the severity of past bites:

Describe in detail the last bite incident (what, when, where, why?):

Any additional comments or information that you think I should know?

PUPPY BEHAVIOR PROFILE

Client's name:

Puppy's name: Breed/Mix: Age:

Sex M ❑ F ❑

Date:

Please respond to the following items by placing an X over the point that most accurately describes your puppy's behavior. In order to give me a clearer picture of what you would like to gain from puppy training, please place an O over the point on the continuum that best represents your ideal.

For example:

	O X	
NEVER PLAYS	• • • • • / • • • • •	TOO PLAYFUL, NEVER STOPS

A. VERY STUBBORN AND WILLFUL	• • • • • / • • • • •	EXTREMELY COOPERATIVE
B. CONSTANTLY BITES	• • • • • / • • • • •	NEVER BITES
C. HARDLY PAYS ANY ATTENTION TO ME	• • • • • / • • • • •	FOLLOWS ME EVERYWHERE
D. AFRAID OF EVERYONE	• • • • • / • • • • •	LOVES EVERYONE TO A FAULT
E. NERVOUS AROUND OTHER DOGS AND PUPPIES	• • • • • / • • • • •	ENJOYS PLAYING WITH OTHER DOGS AND PUPPIES
F. CANNOT WAIT OR CONTROL ITSELF	• • • • • / • • • • •	CAN WAIT FOR PERMISSION IN MOST SITUATIONS
G. EATS SLOWLY AND IS FINICKY	• • • • • / • • • • •	GULPS DOWN FOOD AND WATER
H. CANNOT KEEP FOCUSED ON ONE THING	• • • • • / • • • • •	VERY ATTENTIVE IN MOST SITUATIONS INSIDE OR OUT
I. CANNOT SIT STILL	• • • • • / • • • • •	VERY QUIET AND SLEEPS A LOT

J. EXCITED AND JUMPS UP ON GUESTS	• • • • • / • • • • •	FRIENDLY BUT NEVER JUMPS UP ON GUESTS
K. FEARFUL OF EVERYTHING	• • • • • / • • • • •	CONFIDENT IN ALL SITUATIONS
L. FRETS AND WHINES EVERY NIGHT	• • • • • / • • • • •	GOES TO SLEEP WITHOUT EVER COMPLAINING
M. BECOMES VERY ANXIOUS WHEN LEFT ALONE	• • • • • / • • • • •	SHOWS NO CONCERN WHEN LEFT ALONE
N. GROWLS OR SNAPS WHEN TAKING FOOD OR TOYS	• • • • • / • • • • •	GIVES UP TOYS AND FOOD WITHOUT ANY STRUGGLE
O. PREFERS AGGRESSIVE PLAY AND CHASE GAMES	• • • • • / • • • • •	LIKES PETTING AND GENTLE PLAY
P. APPEARS TO LEARN VERY SLOWLY	• • • • • / • • • • •	APPEARS VERY BRIGHT AND LEARNS QUICKLY
Q. ALWAYS RESISTS LEARNING ANYTHING NEW	• • • • • / • • • • •	ENJOYS LEARNING AND APPEARS TO WANT TO PLEASE
R. COMPLETELY OUT OF CONTROL, PULLS HARD	• • • • • / • • • • •	WALKS CALMLY AT MY SIDE AND NEVER PULLS
S. URINATES AND DEFECATES EVERYWHERE	• • • • • / • • • • •	NEVER HAS ANY ACCIDENTS INSIDE THE HOUSE
T. CHEWS EVERYTHING IN SIGHT	• • • • • / • • • • •	LIMITS CHEWING TO TOYS
U. ALWAYS NEEDS TO BE THE CENTER OF ATTENTION	• • • • • / • • • • •	LIKES ATTENTION BUT CAN DO WITHOUT IT
V. COMES ONLY WHEN FORCED	• • • • • / • • • • •	COMES WHEN CALLED
W. RUNS AWAY WHEN OFF LEASH	• • • • • / • • • • •	ALWAYS STAYS NEARBY

PROFILE SCORE SHEET

Client's name:

Puppy's name: Breed/Mix: Age:

Sex M ❑ F ❑

Date:

The owner's responses to the above items are quantified by giving a numerical value to each of the points on the continuum between 0 and 1. In the case of playfulness:

				O			X					
NEVER PLAYS	•	•	•	•	•	/	•	•	•	•	•	TOO PLAYFUL, NEVER STOPS

PLAYFULNESS: 0.3/0.6, yielding an expectancy divergence of 0.3.

	BEFORE TRAINING	*AFTER* TRAINING
A. COMPETITIVENESS		
B. MOUTHING		
C. INDEPENDENCE		
D. SOCIALIZATION (PEOPLE)		
E. SOCIALIZATION (DOGS)		
F. IMPULSE CONTROL		
G. APPETITE		
H. DISTRACTIBILITY		
I. ACTIVITY LEVEL		
J. GREETING RITUAL		
K. ADAPTABILITY		
L. SEPARATION ANXIETY (NIGHT)		
M. SEPARATION ANXIETY (DAY)		
N. POSSESSIVENESS		
O. AGONISTIC PLAY		
P. LEARNING ABILITY		
Q. LEARNING ATTITUDE		
R. WALKING ON LEASH		
S. HOUSE TRAINING		
T. DESTRUCTIVENESS		
U. ATTENTION SEEKING		
V. RECALL		
W. FOLLOWING BEHAVIOR		

Evaluating the Results

Low scores tend to be characteristic of a well-adjusted, cooperative, and outgoing puppy. High scores may indicate the presence of adjustment problems. Middle-range scores reflect the behavior of the average, balanced puppy. Sharp differences between the owner's assessment of the puppy's behavior and his or her ideal provides a framework from which to develop training plans that focus on relevant target behaviors. The results can be simplified by clustering the various responses around several basic categories of behavior and averaging the scores:

1. COMPETITIVENESS: A, B, F, N, O, R
2. SOCIABILITY: C, D, E, U
3. REACTIVITY: G, H, I, K
4. TRAINABILITY: P, Q, V, W
5. ADJUSTMENT: J, L, M, S, T

PUPPY TEMPERAMENT TESTING AND EVALUATION

The purpose of puppy temperament testing is not intended so much as a tool to prognosticate adult tendencies and behaviors, but to evaluate active behavioral systems as they stand at the time of testing. Temperament tests serve an important function by isolating areas of strength and areas where additional socialization and training are needed. In conjunction with the Puppy Behavior Profile, the temperament test provides an objective means for assessing the puppy's behavioral needs. Temperament tests are carried out by a scorer and a handler (often the owner) working together.

PUPPY TEMPERAMENT TESTING PROCEDURES (HANDLER'S INSTRUCTIONS)

A. SOCIAL ATTRACTION (PASSIVE HANDLER) ▸▸

The social attraction test determines the puppy's level of interest in people and willingness to interact with them. The passive handler stands and calls the puppy by name and may also clap hands. Further encouragement may be offered by crouching down, but as the puppy approaches, the handler should once again stand upright.

B. SOCIAL ATTRACTION (ACTIVE HANDLER) ▸▸

A continuation of the above test but with the handler moving away from the puppy. The handler may encourage the puppy using his name and slapping his or her side. Further encouragement may be given by running in spurts away from the puppy. The passive handler test measure's the puppy's natural willingness to come, whereas the active handler test evaluates this puppy's willingness to follow.

TEMPERAMENT TEST SCORE SHEET

Client's name:

Puppy's name: **Date:**

A. SOCIAL ATTRACTION (PASSIVE HANDLER)

1. Comes, jumps up, and bites hands or clothing.
2. Comes happily with tail erect, vigorous contact.
3. Comes immediately with tail down, less contact.
4. Hesitates, but comes with encouragement, little contact.
5. Puppy does not come.
6. Other:

❑

B. SOCIAL ATTRACTION (ACTIVE HANDLER)

1. Follows, bumps, jumps up, bites, easily distracted.
2. Follows enthusiastically, forging out front.
3. Follows but tail lowered, sometimes lagging.
4. Follows only after hesitation, requiring encouragement.
5. Does not follow.
6. Other:

❑

C. CONTACT TOLERANCE

The handler sits cross-legged on the floor and attempts to pet the puppy over its entire body. The handler should examine its ears and mouth, lift the front and rear paws, and stroke the full length of the tail.

D. PHYSICAL CONTROLS

1. *Jowl control:* The control includes direct eye contact and slight elevation for a second or two.
2. *Stand control:* The puppy is prompted into a stand and restrained in the position for 10 seconds.
3. *Sit control:* From the stand, the puppy is physically prompted into the sit and required to hold the position.
4. *Down control:* The right paw is pulled forward as the handler applies pressure to the puppy's shoulder, causing the puppy to lie down for 10 seconds.
5. *Lateral down:* The puppy is rolled over on its side and held in that position with gentle massage and eye contact for 10 seconds.

E. IMPULSE CONTROL (POSSESSIVENESS)

The puppy is provided with a fresh beef bone (or equally appealing alternative). After allowing the puppy to chew on it for a while, the handler (carefully) attempts to take it away.

F. IMPULSE CONTROL (DELAY OF GRATIFICATION)

The puppy is observed while required to stand quietly waiting for the presentation of a treat. Next, the puppy is required to take the treat gently.

C. CONTACT TOLERANCE

1. Vigorously jumps up, claws, and bites.
2. Jumps up, paws, licks, and sometimes bites.
3. Paws and licks, and stands ground.
4. Licks and tends to roll on side.
5. Avoids being petted.
6. Other:

D. PHYSICAL CONTROLS (JOWL, STAND, SIT, DOWN, DOMINANT-DOWN).

1. Struggles vigorously with biting and clawing.
2. Struggles and bites.
3. Struggles but does not bite.
4. Calms down after a brief struggle.
5. Accepts control without struggle.
6. Other:

Physical controls give a fairly accurate picture of the puppy's relative competitiveness. The controls are carried out in such a way that the puppy is mildly challenged and given the opportunity to react competitively or to accept the prompting with cooperation and subordination.

E. IMPULSE CONTROL (POSSESSIVENESS)

1. Sustained growling and snapping.
2. Protects object with growling.
3. Holds object but releases with muzzle hold.
4. Releases object on verbal request.
5. Shows no interest in object.
6. Other:

F. IMPULSE CONTROL (DELAY OF GRATIFICATION)

1. Sustained lunging and jumping.
2. Lunging and jumping but soon controls impulse.
3. Jumps but quickly settles and waits.
4. Sits or stands quietly for the treat.
5. Will not take the treat.
6. Other:

G. BALL PLAY ▸▸

The puppy is briefly teased with a tennis ball before it is tossed. Each puppy is given three opportunities and graded on the best outcome.

G. BALL PLAY

1. Fetches the ball, but runs away or teases with it.
2. Fetches the ball, but does not bring it back.
3. Fetches the ball, and brings it straight back.
4. Runs after the ball, but does not pick it up.
5. Ignores the ball.
6. Other: ❑

H. RAG PLAY ▸▸

A strip of burlap is wiggled and dragged away from the puppy. If the puppy takes the rag, it is engaged in a brief tug game. The puppy is offered a treat in exchange for releasing the rag.

H. RAG PLAY

1. Takes rag with aggressive growling and will not let go.
2. Takes rag immediately, sustained growling and tugging.
3. Takes rag and tugs, releases on verbal request.
4. Follows the rag but does not take it.
5. Ignores the rag.
6. Other: ❑

I. SEPARATION REACTION ▸▸

The puppy is put in a separate room for 1 minute. The puppy is distracted from barking before being let out.

I. SEPARATION REACTION

1. After ______ seconds, intense distress vocalization and sustained and frantic efforts to escape.
2. After ______ seconds, vocalizes with scratching or digging to escape.
3. After ______ seconds, whines and paws but calms down after ______ seconds.
4. After brief distress, quickly calms down.
5. No reaction.
6. Other: ❑

J. REACTIVITY AND PROBLEM SOLVING (BARRIER FRUSTRATION) ▸▸

The puppy is placed behind a wire barrier that it must go around in order to obtain a highly desirable treat placed in its view and to make contact with the handler.

J. REACTIVITY AND PROBLEM SOLVING (BARRIER FRUSTRATION)

1. Intense distress followed by futile efforts to go through the barrier.
2. Distress followed by several unsuccessful attempts to solve the problem.
3. Some initial distress, but calms down and solves the problem.
4. Shows little distress and solves the problem quickly.
5. No reaction.
6. Other: ❑

K. STARTLE REFLEX

The handler drops a shaker can behind the puppy about 5 feet away. The puppy is reassured afterward and observed for its initial reaction as well as its speed of recovery.

▶▶ K. STARTLE REACTION

1. Barks at the handler.
2. Holds ground and stares at the handler.
3. Crouches down but quickly recovers and approaches.
4. Cowers, recovers slowly and retreats.
5. Frightened and runs away.
6. Other: ❑

Notes and comments:

Recommendations:

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3

Fears and Phobias

"Fear of" is generally "fear about" something. Since fear has this characteristic limitation—"of" and "about"—the man who is afraid, the nervous man, is always bound by the thing he is afraid of or by the state in which he finds himself. In his efforts to save himself from this "something" he becomes uncertain in relation to other things; in fact, he "loses his bearings" generally.

MARTIN HEIDEGGER, *What Is Metaphysics*? (1945)

INCIDENCE OF FEAR-RELATED BEHAVIOR PROBLEMS

Behavior problems often present with some collateral element of aversive emotional arousal, especially fear, anger, anxiety, or frustration. A national survey performed by Goodloe and Borchelt (unpublished data—see Voith and Borchelt, 1996) found that fear

is a common emotional factor motivating dog behavior. The dog-owner respondents were asked to indicate whether their dog exhibited signs of fear "sometimes, often, or always" in various social and nonsocial situations. Of the 2018 dog-owning respondents, 38% indicated that their dog exhibited some amount of fear toward loud noises, 22% reported observing fear toward unfamiliar adults, 33% of the dogs were fearful toward unfamiliar children, and 14% exhibited fear toward unfamiliar (nonthreatening) dogs. Previously, Campbell (1986) surveyed 1422 dog owners about their dog's behavior. The information was obtained from a questionnaire provided to clients at various veterinary hospitals in California. His findings indicated that 20.2% of the respondents observed some degree of fear toward noises, especially in dogs who were over 3 years of age. Statistical reports from animal behavior clinics show considerable variation in the incidence of fear as a behavioral complaint. For example, records from the Animal Behavior Clinic at the University of Pennsylvania (1984 to 1987), indicate that 7% of 489 dogs presenting a behavioral problem exhibited a fear of noises, with 4.3% of the group exhibiting fear toward people (Voith et al., 1993). At the University of Tennessee, Shull-Selcer and Stagg (1991) reported that 30% of the cases they treated at the animal behavior clinic were fear related. Approximately 20% (N = 154 consecutive cases) of the dogs treated by Askew (1996) exhibited fear as a major behavior problem. These figures are in sharp contrast to those reported by Beaver (1994), who found that fear presented in only 1.4% of 855 cases seen at the Texas A&M veterinary behavior clinic.

Assessment and Evaluation of Fear-related Problems

A thorough behavioral history should be recorded and appropriate questionnaires completed by the dog owner. Assessment profiles generally indicate the involvement of one or more of the following etiological factors: (1) genetic or neurobiological predisposition, (2) early socialization or environmental exposure deficits, or (3) aversive or dysfunctional learning. Also, since a variety of underlying medical conditions [e.g., hypothyroidism (Aronson, 1998)] can present symptoms that include apprehensiveness and fear, dogs presenting with fear-related problems suspected of being associated with a physical cause should be referred for veterinary examination. Dogs that are affected by a genetic predisposition are distinguished by a chronic, lifelong, and generalized fearfulness. Such dogs often suffer heightened or extreme sensitivity to sensory input and may habitually overreact to unfamiliar situations. Differentiating a genetic predisposition from socialization or exposure deficits is not always easy, since these etiological factors often present with very similar signs. Temperament information about a dog's sire and dam can be helpful in making such determinations. A history of inadequate socialization or environmental exposure is often associated with persistent fears toward strangers (xenophobia), fear of children (pedophobia), fear of novelty (neophobia), or fear of the outdoors and new places (agoraphobia). In cases where fearfulness is the result of a specific learning event (e.g., startle, trauma, or abuse), a dog's fearful behavior may be limited to a small number of eliciting stimuli and situations or widely generalized. Such dogs are often otherwise very outgoing and confident. Of the aforementioned etiologies, fearfulness stemming from some identifiable learning event is usually the most responsive to behavior modification, followed by problems associated with socialization or exposure deficits. Problems stemming from a genetic predisposition or neurobiological disorder are the most difficult to resolve through behavioral means alone. The resolution of fear problems depends on sorting out fear-eliciting situations and events. The dog behavior consultant must carefully identify the stimuli that evoke fear and the situations in which fearful behavior is likely to occur. Detailed information is collected about the behavior and the locations in which it has occurred in the past. Whenever possible, a functional analysis and assessment should be performed. The results of such analysis are very useful in terms of accurately describing the problem, developing an appropriate plan of behavior modification, and forming a realistic prognosis.

Contributions of Learning

Fear problems involve both instrumental behaviors (escape and avoidance) and underlying motivational states (fear, anxiety, and panic) operating under the influence of classical conditioning. In the laboratory, instrumental and classical learning are often studied separately. Under natural conditions, there is a great deal of interaction and overlap between instrumental and classical conditioning in the learning and unlearning of fearful behavior. Unlike in the laboratory, natural behavior is not arbitrarily divided into distinct voluntary and reflexive categories but is the unified expression of complementary instrumental, cognitive, and motivational factors. Behavior operates under the influence of an animal's *disposition to learn,* including various innate and acquired expectancies and the pressure of numerous motivational imperatives (see *An Alternative Theory of Reinforcement* in Volume 1, Chapter 7). In addition, regulatory feedback mechanisms or *cognitive analyzers* guide behavior according to the relative success or failure of an animal's behavior to achieve intended goals. The relevant motivational substrates operate under the influence of two general constraints:

1. Both attractive (appetitive) and aversive emotional arousal are reflexive in nature and can be altered (amplified or attenuated) only by appropriate procedures involving sensitization-habituation or classical conditioning.
2. Attractive and aversive motivational states can be influenced only by the elicitation of complementary or antagonistic attractive or aversive motivational states.

In other words, motivational states cannot be reinforced or punished by the manipulation of consequences as one finds in the case of instrumental behavior. This observation is not intended to suggest that rewards and punishment have no effect on motivational substrates. In fact, the acquisition of food or the avoidance/escape from aversive stimulation may produce very significant motivational effects via satiation or relief, respectively. The critical issue at stake here is that underlying emotional arousal is not responsive to rewards and punishers in the same way that overt voluntary behavior is affected by instrumental consequences—one cannot punish or reward an emotion.

Classical and Instrumental Interactions

Undoubtedly, cognitive and motivational substrates bring classical behavior and instrumental behavior together into a functional unity. Despite their mutual dependency, however, instrumental behavior and reflexive behavior perform relatively distinct functions. For example, although one can choose not to act in some way or other, one cannot arbitrarily decide to experience or not to experience some emotion. Given the presence of a sufficiently salient stimulus, the emotion will occur and continue to occur until (1) it has run its course (habituation), (2) the eliciting stimulus is terminated (stimulus change), or (3) an antagonistic emotional state is aroused by another stimulus (counterconditioning). In contrast to the constraints associated with reflexive emotional arousal, instrumental behavior exhibits considerable independence from stimulus determinants. Although instrumental behavior operates in conformity with motivational incentives such as fear or hunger, it is not entirely controlled by such incentives. Dogs have at their disposal a great deal of latitude and "choice" about motivationally significant courses of action present at any given moment. This is a very important aspect of how motivational incentives affect instrumental behavior; they do not drive or direct the animal into action—they provide options. Motivational incentives present as a menu of options for action. This feature gives instrumental behavior and learning considerable freedom from biological and emotional pressures, that is, it is characterized by a high degree of voluntary initiative and purposiveness.

Fear and Instrumental Reinforcement

A further distinction should be drawn with respect to the relationship between motivational influences and instrumental reinforcement. Although instrumental behavior may heed motivational pressures to take some course of action, sometimes to the extent of

blurring instrumental and reflexive distinctions, the reduction of an aversive drive state does not appear to be the most important factor involved in the reinforcement of instrumental behavior. The common view that reinforcement is the result of a response-produced drive reduction has been largely repudiated in the learning laboratory. This is not to say that a drive-reducing outcome (that is, an event that satisfies some need) might not play a significant role in reinforcement. Certainly, the reduction or induction of drive may play a vital motivational role by lowering or raising thresholds for arousal and activity (that is, the disposition to learn); however, these changes in motivational state appear to exercise only a secondary influence on instrumental reinforcement. Reinforcement of instrumental behavior appears to hinge more directly on the recognition that some behavior successfully controlled the occurrence of a motivationally significant outcome. The central idea being developed here is that reinforcement is based more on the exercise of successful control over some attractive or aversive outcome than it is on the reduction of a drive or motivational state. The reduction of motivational arousal may alter a dog's disposition to act, but it is a secondary or collateral effect associated with the successful control of attractive or aversive outcomes.

In contrast, classical conditioning depends on the formation of a predictive relationship between the occurrence of two stimulus events such that, given that S1 occurs, S2 will probably follow. Classical conditioning provides predictive information about the occurrence of significant events, thereby motivationally preparing dogs to act in an adaptive and effective manner. Such conditioned associations require the presentation of an antecedent conditioned stimulus (CS) occurring in close temporal and spatial proximity with the occurrence of a biologically significant unconditioned stimulus (US). As already noted, there is a close interdependent relationship between classical learning and instrumental learning: *Successful control depends on adequate prediction, and adequate prediction depends on successful control.* Adaptation to the changing environment depends on an animal's ability to predict and control appetitive and aversive events (see *A Brief Critique of Traditional Learning Theory* in Volume 1, Chapter 7).

The foregoing general observations have considerable relevance for the modification of behavior associated with fear. The mere reduction of some aversive emotional state (e.g., counterconditioning) may not be sufficient in itself to alter associated instrumental avoidance/escape behavior. Although counterconditioning can be a very useful preliminary step in the management of intense fear, the ultimate goal is to "convince" dogs that they can control or cope with the feared situation. Fear is overcome by confidence building. Demonstrating to fearful dogs that they can control the feared situation is often a very effective treatment approach. Consequently, a critical concern in behavior modification is that the animal learn to control feared events in a constructive and purposive way. Many common fears appear to be related to a lack of competency in the face of some unfamiliar or potentially dangerous situation. For example, dogs that are fearful of water will probably not become much better when being taken near water, unless they are also taught through gradual steps how to swim or otherwise enjoy it. As a dog's confidence improves, activities such as retrieving games can be added to the experience, showing the dog that being in the water can be fun, as well. Obviously, simply reducing the aversive emotional arousal associated with such situations would not go very far in permanently resolving a dog's fear of water. Similarly, a dog that is fearful of climbing stair steps is best treated by gradually teaching it the necessary motor skills needed to climb steps.

A relatively complex interface between instrumental and classical conditioning exists in the relationship between fear and aggression (see Chapter 7). Although some degree of directive training (e.g., response prevention and attention control) is often needed for the resolution of fear-related behavior problems, excessive reliance on inhibitory techniques is not useful and should be avoided. The risk of exacerbating undesirable emotional arousal through punishment is particularly problematic in the case of fear-related aggressive behavior. Punishment may partially or temporarily suppress aggressive behavior but will

not reduce underlying aversive emotional tensions driving the behavior. Under such circumstances, any hope for a permanent solution is highly doubtful. Such treatment, if it succeeds at all, may only train a dog to avoid behaving aggressively under circumstances in which punishment is likely to occur. Unfortunately, since the provocative stimuli and the underlying aversive tensions involved have not been properly identified or addressed, they will likely persist over time, ultimately producing an even more difficult and dangerous situation. Similarly, while avoidance behavior can often be temporarily suppressed by punishment, the underlying fear motivating such behavior is not reduced by punitive treatment. Fear-related behavior problems are the result of a composite of instrumental and classical conditioning elements, each requiring specific behavior modification efforts.

What Is Fear?

Freeze, Flight, and Fight Reactions

Fear is a normal self-protective response to potentially injurious stimulation. There are three broad ways in which adaptive fear is expressed: freeze, flight, and fight. Freezing is an inhibitory response to fearful arousal that is typically elicited by low levels of stimulation or a distant threat. Fleeing, on the other hand, is an excitatory response to fearful arousal that is elicited by high levels of fear or the close presence of an intrusive threat. Fear-elicited fighting occurs in situations involving intense fearful arousal and where flight is blocked by the threatening target. Normal fear is adaptive and transient. In addition to freeze-flight-fight responses, fear drives the expression of a wide range of preparatory physiological changes and overt species-specific defensive reactions (Bolles, 1970).

Signs of Fear

Outward signs of fear include a variety of distinctive body postures, facial expressions, and physiological indicators (see *ANS-mediated Concomitants of Fear* in Volume 1, Chapter 3). Depending on the fear-eliciting situation, dogs will freeze, attempt to escape (e.g., strain away, hide, or cower), or attack. Postural signs of fear include lowering and arching of the body, tucking the tail tightly between the legs, raised hackles (piloerection), intense muscular stiffening (flexor dominance), and thigmotactic reactions that frequently involve efforts to lean on the owner or against some other object (including the floor), apparently seeking security and support. A fearful dog will often lower its head and avert eye contact, fasten its ears back, and retract the corners of its mouth. Other signs of fear include pupillary dilation (mydriasis), restlessness, panting, nervous licking, shivering and trembling, decreased and thick salivation (sympathetic arousal), and, in some cases, profuse watery salivation (parasympathetic rebound). In the case of extreme fear arousal, dogs may exhibit tonic immobility (catalepsy), lose bowel and bladder control, or evacuate anal glands. Fearful dogs may scramble frantically to escape or evade a feared object while loudly whining, yelping, yipping, or shrieking. In addition, depending on the dog's temperament and past experience, fearful stimulation may evoke a defensive attack, especially in situations where the dog is restrained or prevented from escaping.

Innate and Acquired Fear

Phylogenic Sources of Fear

Adaptive fear is often evoked by unconditioned aversive stimuli that have evolutionary significance for dogs. These phylogenic sources of fear include such triggers as pain, rapid stimulus change, loud noises, sudden movements, heights, strangers, isolation, fire, water, and unfamiliar social and environmental situations. Phylogenic or *natural triggers* of fear are associated with imminent threat and evoke preparatory physiological arousal mediating species-typical escape responses.

Although natural triggers of fear such as pain and loud noises are correlated with fear, they are not fear itself. What an animal strives to control by escape and avoidance is fearful arousal, and only secondarily loud noises or pain insofar as they elicit fear. For example, storm-phobic dogs treated with an appropriate medication will more calmly tolerate thunder and lightning going on around it.

While under the influence of medication, fear is reduced, and dogs no longer exhibit an urgent need to escape. Thunder and lightning are still present in the situation—what is absent under the influence of medication is fearful arousal.

Ontogenic Sources of Fear

Ontogenic sources of fear are largely the result of learning and experience. Motivationally neutral stimuli that happen to occur in close association with unconditioned fear may become predictive signals that help an animal anticipate an impending threat. These learned sources of fear evoke apprehensive arousal and corresponding purposive behavior aimed at avoiding the phylogenic trigger of fear. Successful avoidance occurs when anticipated *fear* arousal is prevented or postponed by appropriate behavior. Fear asserts itself when the CS no longer adequately predicts the US or when a previously effective avoidance response no longer adequately controls the occurrence evoking the aversive US.

Early experiences appear to be vital for the development of social confidence and competence. Scott and Fuller (1965) and others (see below) have demonstrated that puppies that are isolated from social contact early in life develop pronounced fear-related deficits that persistently interfere with their ability to engage in normal social transactions with other dogs and humans. Similarly, puppies not exposed to sufficiently varied environments and stimuli become progressively fearful of novel stimulation as they mature.

Pathogenic Sources of Fear

Pathogenic fear (generalized anxiety and phobia) occurs when the evoking aversive US can be neither predicted nor controlled, that is, when fearful arousal cannot be avoided or escaped. Pathologically anxious or phobic dogs are unable adaptively to escape or avoid fearful arousal. Since fear arousal persists in spite of their best efforts, these dogs labor futilely under the influence of escalating fear and anxiety. Overt fearful behavior in the presence of fear-eliciting stimuli continues unabated and becomes progressively disorganized and maladaptive. The fear may become *free floating* and uncontrollable; it can be neither avoided nor escaped, but these dogs are obliged to keep trying. Such pathological or abnormal fear may persist across contexts and interfere with a variety of adaptive social and environmental transactions.

Acquisition and Persistence of Fear

Phylogenic fears do not depend on associative conditioning, although the magnitude of their expression is strongly influenced by the opposing influences of habituation and sensitization. Further, even when natural triggers do not evoke significant fear, they are influenced by a fear-expectancy bias or preparedness that facilitates rapid acquisition following aversive stimulation (sensitization). Many phylogenic elicitors of fear are highly prepared and effective in the absence of conditioning or sensitization. Pain, for example, is a powerful source of fear and is commonly used in the laboratory for studying fear. However, the fear associated with pain is not only affected by sensitization; it can also be reduced through habituation or counterconditioning. For example, recall Pavlov's experiment in which a dog was gradually exposed to increasing levels of shock followed by the presentation of food (see *Counterconditioning* in Volume 1, Chapter 6). As a result of the gradual intensification of shock and the presence of countervailing appetitive stimulation, the dog learned to tolerate even intense levels of shock, showing little more than an orienting response in the direction of expected food when the shock was delivered (Pavlov, 1927/1960).

Although fearful behavior appears to be influenced by several hereditary factors, including biological expectancy biases and relative sensitivity to fear-eliciting triggers, thresholds for fear are strongly influenced by experience and learning, especially the modulatory effects of sensitization and habituation. Phylogenic elicitors of fear may undergo significant ontogenic modification as the result of habituation (decreased sensitivity) and sensitization (increased sensitivity) to the evoking fear trigger. In addition, aversive classical conditioning may cause neutral stimuli, not normally capable of eliciting fear arousal, to

become conditioned aversive stimuli by virtue of their association with unconditioned elicitors of fear. Perhaps the most important way in which fear is adaptively modulated toward phylogenic elicitors is through learning. By learning how to control and cope with natural sources of fear, animals develop confidence (incompatible with fear) around threatening situations. Many activities that are highly reinforcing for humans derive their reward value from the elation resulting from the successful control of fear-eliciting situations. Activities such as rock climbing, skiing, parachuting, and others taking place at great heights would be terrifying if it were not for the adventurer's mastery over the dangers presented by heights. The elation produced by these various activities is in proportion to the fear avoided by overcoming the dangers involved.

Other potentially viable explanations for the persistence and elaboration of fear reactions have been described. According to the James-Lange theory of emotions, the experience of fear results from a *perception* of underlying autonomic and bodily changes associated with fearful arousal. The underlying emotional substrate is different from the perceived experience felt by the animal. If this theory is accurate, the perception of fear is cognitively distinct from the original autonomic reactions. Taking this one step further, perhaps the *perception* or representation itself becomes an internal fear-eliciting CS that, in turn, triggers a specific set of autonomic fear reactions when recalled. This view could help to explain how imagining fearful experiences by human subjects results in the elicitation of fear and autonomic arousal. Gantt's theory of schizokinesis is relevant to this topic (see *Gantt: Schizokinesis, Autokinesis, and Effect of Person* in Volume 1, Chapter 9). *Schizokinesis* refers to a divergence between overt changes directly associated with classical fear conditioning and underlying visceral and autonomic concomitants. Gantt (1962) postulated that Pavlovian conditioning and extinction occur at different rates depending on the biological system involved. While overt motoric reactions associated with fear may be readily extinguished, autonomic components like heart rate and blood pressure may persist long afterward. Perhaps these perennial autonomic traces signal fearful perceptions or prompt fearful recollections that in turn trigger broader and more intense emotional arousal.

Fear and Conditioning

Fear is elicited by a variety of unconditioned and conditioned stimuli. Like other forms of emotional arousal and reflex actions, fear can be elicited by conditioned stimuli. The conditioning of fear is the primary way in which fear irradiates to nonaversive or neutral stimuli occurring in close association with the fear-eliciting situation. The process follows the basic Pavlovian pattern: a stimulus occurring prior to the onset of a fear-eliciting event may acquire the ability to elicit similar preparatory arousal as the feared event. Conditioned emotional responses (CERs) produced in this manner are common in dog behavior and training. For instance, the reprimand "No" is conditioned by pairing the word "No" (CS) with a mildly startling or aversive event (US). After several trials in which the reprimand CS is presented in close contiguity with the aversive US, the CS will acquire startling and inhibitory properties belonging originally only to the aversive US.

Under ordinary circumstances, the ability to form fearful associations linking innocuous predictive events with impending threatening ones is highly adaptive and useful. By using environmental signals or *markers* that regularly precede the occurrence of a threatening event, animals are better equipped to anticipate danger safely and, perhaps, reduce or evade harm by prompt action. Such signals provide animals with temporal and spatial information about an aversive event, allowing them to avoid, evade, or postpone the event's occurrence. Once established, such conditioned stimuli are frequently very difficult to extinguish (see *Classical Conditioning and Fear* in Volume 1, Chapter 6).

Conditioning and Maladaptation

Although learning involving fear is normally adaptive and functional, sometimes fear learning becomes dysfunctional and maladaptive. Wolpe (1969) suggests that neuroses involving fear can be distinguished from normal

responses by "their resistance to extinction in the face of their unadaptiveness" (1). Such persistent and apparently maladaptive avoidance responding often occurs following traumatic exposure to aversive stimulation. Solomon and Wynne (1953), who studied the effects of traumatic aversive conditioning on avoidance learning and extinction in dogs, trained them to jump over a hurdle separating two compartments of a shuttle box. Each compartment was separately illuminated by an overhead lamp. During the experiment, darkness became a discriminative stimulus predicting impending shock, while the light confirmed successful avoidance and predicted *safety.* The dogs quickly learned to leap over the hurdle whenever the compartment was darkened—on average, within five trials.

The resultant avoidance behavior was not only rapidly learned (often after a single occurrence), the behavior was also very resistant to extinction. The experimenters ran several hundred regular extinction trials, with one dog continuing to jump over 600 times, even though shock never occurred—the aversive CS (darkness) was sufficient to maintain the behavior. The experimenters observed that avoidance responding continued unabated with progressively shorter latencies between the presentation of the CS and avoidance response, even though overt signs of fear appeared to diminish over time. After 10 to 12 days of extinction, most of the dogs stopped resisting when prompted to go into the shuttle box, with many voluntarily hopping inside without any noticeable sign of emotional distress. These latter findings suggest that a certain degree of motivational independence exists between fear and avoidance behavior. Interestingly, with respect to compulsive behavior disorders, the authors noted that overt signs of fear were most reduced in dogs that had adopted some preliminary stereotypic pattern (superstition) that occurred just before and after the avoidance response was emitted.

Conditioned Fear and Extinction

In a follow-up study, Solomon and coworkers (1953) used several methods to extinguish traumatic avoidance behavior. They found that a combination of procedures, including response prevention (blocking) and punishment, offered the most effective means for extinguishing (or suppressing) avoidance responding. The term *punishment* in this case denotes the discontinuation of the avoidance contingency; that is, the avoidance response no longer successfully avoids or escapes the presentation of the aversive stimulus. [There is some apparent confusion in the literature with respect to the definition of *extinction* in case of negative reinforcement. Catania (1998) comments on this problem: "In negative reinforcement (escape and avoidance), extinction has often referred to the discontinuation of aversive stimuli, although the term applies more appropriately to discontinuing the consequences of responding, so that aversive stimuli occur but responses no longer prevent them" (389).] A punishment-extinction contingency alone did not prove to be very effective; in fact, it appeared to increase the strength of the jumping response in most dogs. A response prevention (blocking) procedure was also employed. In this case, a glass panel was installed above the hurdle, thus preventing the dogs from jumping over it. This procedure helped to facilitate extinction in some dogs. However, the best extinction results were achieved by alternately employing both response blocking (what the experimenters called *reality testing*) and punishment.

One possible explanation for the slow extinction rates observed in the aforementioned experiments is that the dogs lacked sufficient information about the altered significance of the training situation; that is, they failed to learn that the avoidance response was no longer necessary or functional. By blocking some avoidance responses and punishing others, both the necessity and the functionality of the avoidance response were disconfirmed. The need to block avoidance responding in order for the animals to learn the significance of altered contingencies was also suggested by an experiment performed by Wolpe (1958), who found that cats exposed to shock in the presence of food could be induced to eat again by forcing them into close proximity to food by using a squeeze panel. Once near the food

(and unable to escape), the hungry cats appeared to realize that the threat of shock was no longer present and suddenly tested the situation by taking a few quick grabs and gulps of food before relaxing enough to eat normally in the experimental setting.

Many common fears are maintained under the shielding influence of successful avoidance behavior. In effect, successful avoidance prevents animals from learning that the contingencies associated with the situation have changed and no longer represent a threat. Although the avoidance behavior is no longer adaptive, dogs may continue to respond as though it were necessary to do so. Such avoidance behavior is particularly relevant in the maintenance of some compulsive behaviors in dogs. Consequently, successful extinction of avoidance behavior may require that the behavior be prevented, forcing dogs to experience directly the *reality* that the response is no longer necessary. Response prevention procedures have been demonstrated to be highly effective for the reduction of avoidance behavior and fear. Although it is not precisely clear what mechanisms actually facilitate response prevention (Mineka, 1979), some combination of extinction, competitive learning, relaxation, or cognitive reappraisal is probably involved.

Fear, Cognition, and Avoidance Learning

Seligman and Johnston (1973), who analyzed avoidance learning from a cognitive perspective (see *A Cognitive Theory of Avoidance Learning* in Volume 1, Chapter 8), theorized that once an avoidance response is learned, fear as a motivational factor fades into the background, becoming secondary to cognitive sources of reinforcement. According to this theory, avoidance is not primarily maintained by fear reduction, as postulated by two-factor learning theorists, but by the confirmation of an expectancy that the occurrence of aversive stimulation is controlled by the avoidance response. These response expectations include what to expect as the result of responding, as well as what to expect if the response does not occur. During avoidance training, animals learn to expect that (1) shock will not occur if the response is made and (2) shock will occur if the response is not made. Since the absence of shock is preferable to the presentation of shock, animals learn to respond. If the foregoing expectations are confirmed, then the response is reinforced. On the other hand, if one or both of these expectations are disconfirmed, the response undergoes extinction. This construct is consistent with the experiments of Solomon and colleagues. Once the dogs learned that they could safely predict and control the occurrence of the aversive event, collateral fearful arousal was gradually offset by the appearance of confidence. As a result, the dogs became progressively confident and relaxed as training went on.

The pattern of avoidance responding that follows traumatic avoidance conditioning does not depend on the repeated presentation of the feared aversive event. Each time the dogs successfully jumped over the barrier, their confidence improved. Since avoidance behavior is reinforced by the absence of aversive stimulation, it would not become apparent to the dogs that the avoidance response was no longer necessary during the extinction phase, unless, of course, they happened to stop responding and discovered that shock did not occur. In the case of traumatic avoidance learning, though, few animals stop to check whether the contingency is still in effect. In variance with Wolpes's suggestion that such behavior is "neurotic" and "unadaptive," one might instead view persistent avoidance responding as a potentially highly adaptive pattern, especially in situations involving traumatic or dangerous events. Under such circumstances, stopping to test whether a particular avoidance response was still necessary would entail taking a potentially life-threatening risk. Unlike the laboratory situation, where predictive signals may be arranged arbitrarily, in nature such predictive relations are often much more consistent and reliable. Some persistent fears and phobias in dogs may be similarly interpreted as an adaptive response misapplied. This interpretation is especially relevant in cases involving traumatic fears, where *testing* the situation might be perceived as a dangerous risk that they are not willing to take.

Safety, Relief and Relaxation

The intention of the foregoing discussion is not to suggest that *fear* does not play a significant role in avoidance learning but rather to emphasize the important role of cognitive sources of reinforcement in such learning. A cognitive-behavioral approach to avoidance learning appears to account for more of the facts than either alone can explain. That fear plays a role in the maintenance and regulation of such behavior is supported by many experiments. A good example of these numerous studies is the research performed by Rescorla and LoLordo (1965), who trained dogs to avoid shock in an arrangement similar to the one already described in the Solomon-Wynne experiment. In their experiment, however, dogs were not provided with external avoidance cues but had to learn to jump in accordance with a temporal contingency (Sidman avoidance task—see *Mowrer's Two-process Theory of Avoidance Learning* in Volume 1, Chapter 8). In addition, two stimuli had been previously conditioned, one to predict shock (fear CS), and one to predict the absence of shock (safe CS). The researchers found that the rate of jumping was differentially affected, depending on the CS presented. The fear CS increased the rate of responding when it was presented, whereas the safe CS decreased avoidance responding. These findings clearly indicate that *fear* and *safety* play significant motivational roles in the modulation of avoidance behavior.

In addition to the confirmation of relevant expectancies, the jumping response may also be reinforced by consequent relief and relaxation associated with the successful performance of each avoidance response. Denny (1983) describes the combined effects of relief and relaxation:

> Relief is conceived of as a short latency, autonomic event that lasts only 15 to 20 sec. Relaxation, on the other hand, seems to be a long latency, striate muscle event that requires at least a 2.5-min non-shock period to be effective. Both relaxation and relief are assumed to be effective in making the stimuli associated with a nonshock period positive, or safe, during the acquisition of avoidance and in providing the responses that can compete with fear and help mediate its extinction. According to the theory, both relief and relaxation occur automatically with the extended removal of an aversive or well-conditioned aversive stimulus. Nothing else is required. (215)

In addition, Denny (1971) suggests,

> Such relief and relaxation affects produced by avoidance may backchain to the fear-eliciting CS, gradually counterconditioning it and making it into a "cue for approaching safety." (253)

In combination with Seligman and Johnston's cognitive theory, Denny's notion of safety provides a persuasive explanation for the persistence of avoidance learning and its relatively relaxed and *fearless* character.

Response Prevention, Opponent Processing, and Relaxation

Baum (1970) argues that relaxation plays an important role in the mediation of extinction by response prevention (flooding). Animals exposed to a fear-eliciting situation exhibit "abortive avoidance behavior," freezing, and increased general activity but gradually settle into a period of grooming activities. He interprets the appearance of nonfearful grooming (calming) as evidence of relaxation. According to Baum, postfear relief and relaxation are necessary affective changes for flooding or response prevention to reduce fear. In fact, premature termination of a flooding session (that is, before dogs show evidence of relaxing) may make the fearful behavior worse rather than better.

Under normal conditions, relief and relaxation help to regulate fear, perhaps by mediating affective habituation. Another possibility is that relief and relaxation are opponent processes operating in the manner described by Solomon and Corbit (1974) (see *Classically Generated Opponent Processes and Emotions* in Volume 1, Chapter 6). According to this theory, the arousal of fear is followed by hedonically opposing arousal. The course of events described by Solomon and Corbit is consistent with that outlined by Denny; however, some additional features of the opponent-process theory nicely account for the effects observed when a fear-eliciting stimulus is repeatedly presented. The assumption of the opponent-process theory is that high lev-

els of fear are followed by proportionate "slave" responses of an opposite hedonic valence (e.g., relief/relaxation). When the fear-eliciting stimulus is discontinued, these shadowing opponent affects assert themselves. An interesting characteristic of opponent processing occurs after repeated stimulation. Gradually, fearful arousal becomes less strong, apparently subdued under the restraining influence of growing antagonistic opponent processes. As a result of the repeated termination of fear-eliciting stimulation, heightened levels of antagonistic arousal progressively exert a more pronounced and longer-lasting relaxation/relief effect. Theoretically, this arrangement would provide a powerful means for modulating fear and for promoting adaptation in fear-dense environments. In the case of phobias or generalized anxiety, opponent relief/relaxation effects may fail to develop fully, may be sluggish, or may not exert sufficient strength to offset fear. One possible explanation for the failure of opponent mechanisms in the case of extreme fear is that, during particularly traumatic events, fear arousal may exceed the capacity of the opponent-processing mechanism. Instead of restraining fear arousal toward baseline levels or below baseline levels (relief/relaxation), opponent processes may only be able to partially restrain fear arousal (phobia).

Anxiety

Fear is an adaptive emotional response to a specific event or situation that threatens to produce injury. The elicitation of fear activates animals physiologically and behaviorally for immediate emergency action appropriate to a situation. In contrast to the acute onset and temporary duration of fear, anxiety is characterized by a chronic state of nonspecific apprehension, persistent sympathetic arousal, and vigilance. Anxious dogs appear tense and physiologically braced for a threat that they cannot adequately predict, perhaps one that does not actually exist. Chronic anxiety generates stressful sympathetic arousal and underlies the development of many behavior problems, including unpredictable aggression, generalized neophobic and xenophobic tendencies, various neurotic compulsive disorders, and psychosomatic disorders. Recently, Glickman and coworkers (2000) have reported a significant correlation between fearfulness and agitation in response to strangers and a higher incidence of gastric dilatation-volvulus. Interestingly, the authors found that dogs (N = 1914) perceived by their owners to be happy were less likely to develop this relatively common and often life-threatening disorder.

Fear, Anxiety, and Predictability

From a learning perspective, the functional difference between anxiety and fear is the degree of independence between the fear response and a specific eliciting CS or US. Fear occurs in the presence of some specific stimulus or situation. When the aversive stimulus is discontinued, fearful arousal rapidly dissipates and is replaced by relief. Adaptive fear occurs in one of two situations: (1) as the result of direct stimulation by an evoking fear US or (2) as the result of the presentation of an evoking CS that is highly correlated with a fear-eliciting US. In the first situation, the elicitation of fear facilitates withdrawal from a potentially dangerous situation (escape). In the second case, anticipatory fear enables dogs to avoid the threatening situation (avoidance). Whereas a strong connection exists between fear and some evoking CS or US, maladaptive anxiety occurs independently of specific stimulation or imminent threat.

Although often maladaptive, anxiety can serve a highly adaptive function under certain circumstances. Imagine, for example, an impending event that might occur but cannot be anticipated by any available warning sign. Anxious arousal in such cases increases an animal's vigilance and prepares it to act effectively, just in case the event happens to occur.

Rescorla's Associative Interpretation

In the case of anxiety, the threatening event is not well predicted; that is, the threatening US is apt to occur independently of predictive conditioned stimuli present at the time. Post-Pavlovian theories of associative learning offer an excellent way for understanding how some anxious states are acquired and maintained

(Rescorla, 1988). Of particular significance in this regard is Rescorla's reformulation of classical conditioning. Rescorla experimentally demonstrated that associative learning incorporates information about both the occurrence and the nonoccurrence of significant events. According to this model, excitatory conditioning (acquisition) occurs when the US is highly correlated with the presentation of the CS. On the other hand, inhibitory conditioning (extinction) occurs when the US is poorly correlated with the presentation of the CS.

When the US occurs independently of the presence or absence of the CS, the US is defined as unpredictable; that is, both the occurrence of the CS as well as its omission are equally irrelevant to the occurrence of the US. A positive predictive value is assigned to the CS if it occurs more frequently than not before the US is presented. A negative predictive value is assigned to the CS if it occurs more frequently than not when the US is omitted. Therefore, the predictive value of the CS is expressed numerically between 1.0 (certainty) and 0.0 (unpredictable). The vast majority of conditioned stimuli fall somewhere between these two opposing extremes. When faced with a potentially aversive or life-threatening event that is not adequately predicted by antecedent signals, the organism is forced to maintain a chronic state of alarm, vigilance, readiness for action. This state of hyperarousal is associated with persistent anxiety and generalized biological stress. This sort of condition is highly aversive and appears to be related to the loss of safety ensuing in situations where aversive events are unpredictable (Seligman and Binik, 1977).

Denny (1971) proposes a novel hypothesis concerning the development of generalized or free-floating anxiety. According to this theory, anxious persons or animals are unable to relax properly, and this dysfunction is relatively independent of external stimulation. Instead of external cues evoking anxiety, the source of aversive stimulation is internal. Denny has argued for the possibility that affects associated with relaxation may themselves evoke anxiety. Under situations in which relaxation is regularly paired with aversive stimulation, fear may be elicited by relaxation-produced internal cues. Because of past presentations of aversive stimulation occurring with the onset of relaxation, dogs may be unable to calm down because each time they begin to feel relaxed, they begin to become anxious. One would assume that such associations might be particularly likely in cases where aversive events occur independently of other predictive cues. Under such circumstances, the most constant predictive correlation with aversive outcomes might very well be relaxation. A somewhat similar factor might underlie other forms of excessive arousal, where calming or slowing down might become a cue predicting aversive stimulation.

PHOBIA

Phobias are distinguished from other conditioned and unconditioned fears by their maladaptive character. Given the presence of a phobic stimulus, a fearful response invariably follows. Fear associated with phobias is typically far in excess to what would be expected or appropriate in the situation. Another important distinction between most phobias and common fears is the former's persistence and failure to habituate naturally. Even after many hundreds of harmless contacts with the feared object or place, a dog may continue to exhibit a strong phobic response without showing any sign of abatement over time (Hothersall and Tuber, 1979).

Biological Predisposition and Preparedness

Understanding how phobias develop is not an easy task, and the etiology of many phobic disorders still remains a mystery. Although a specific traumatic event can occasionally be identified to help explain the appearance of some phobia, most often the cause of phobic behavior is not clearly linked to a past aversive event (Marks, 1987). Some dogs appear to be biologically predisposed to behave more fearfully or to develop phobic responses more easily than others, which may be more emotionally resilient or virtually immune to disorders resulting from fearful stimulation. Seligman (1971) proposed a *preparedness* account to explain why some fearful associations are

acquired more readily than others. Preparedness affects both the classical conditioning of fear and the acquisition of instrumental defensive (escape and avoidance) responses—what Bolles (1970) refers to as species-specific defensive reactions. Seligman divides preparedness into three basic categories, depending on the relative ease with which fearful associations are learned: (1) prepared (fast—sometimes one trial), (2) unprepared (slow—requires extensive associative training), and (3) contraprepared (retarded—may occur only after extensive training or not at all).

Species-specific Objects of Fear

LoLordo and Droungas (1989) suggest that some phobic responses and their objects may be inherited as highly prepared species-specific tendencies. One example of an apparent inherited fear is a puppy's fear of heights. Most young puppies exhibit a fear of heights shortly after they are able to move about. These innate fears do not require traumatic associative learning in order to be activated but appear spontaneously as part of an animal's ontogenetic development (Menzies and Clarke, 1995). Another innate fear that is commonly associated with phobic behavior is the fear of loud noises (see *Preparedness and Selective Association* in Volume 1, Chapter 5). Finally, the most common source of aversive emotional arousal is pain. The fear of pain is a very powerful source of fear and widely distributed among animals.

Some dogs exhibit a pronounced fear of strangers (xenophobia) in spite of conscientious socialization efforts. Strong evidence suggests that a heritable biological factor influences the development and expression of tendencies for social attraction and aversion. Murphree (1973), for example, has selectively bred divergent strains of pointers. One line shows a normal attraction and social responsiveness toward human handlers. The other nervous line exhibits a persistent social aversion toward people that is transmitted from one generation to the next. The pathological pointers exhibit intense fear and withdrawal behavior whenever they are approached by human handlers, regardless of the dogs' previous socialization with humans and training. Interestingly, the nervous dogs get along well with normal pointers (Reese, 1979) and even respond well to field training.

The appearance of phobias may be causally related to the affected dog's inability to habituate normally to feared stimuli or as the result of sensitization, that is, intense or surprising exposure to the feared object or situation. Dogs exhibiting sensitive or "weak" temperament traits or suffering hypersensitivity to touch or sound are especially prone to develop adult phobias. Such predisposed individuals frequently suffer compound fears involving a wide variety of objects and situations.

Typically, natural fears are attenuated or amplified through the mutually antagonistic influences of habituation and sensitization, respectively. For example, safe encounters with other dogs from puppyhood onward will progressively raise a dog's threshold for fear in the presence of other conspecifics. On the other hand, being attacked on some occasion by an unfamiliar dog may result in the development of a lifelong fear of other dogs. Fear can also spread to other stimuli that share some similarity with the US through generalization.

Traumatic Conditioning

Traumatic experiences occurring early in puppyhood are a major source of phobic behavior in adult dogs. Puppies between 8 and 10 weeks of age appear to be especially sensitive to the effects of fearful stimulation (Fox, 1966). A highly persistent phobia may result from a single traumatic exposure during this critical period. For example, an 8½-week-old puppy known to have been stung by a bee just above his left eye developed a lasting fear of bees and other flying insects that continued for over 10 years despite thousands of safe exposures during that time. Although the dog's response was particularly strong while indoors (the context in which he had been stung), he continued to show signs of fear arousal in response to all flying insects regardless of the situation. This particular dog was otherwise very confident, independent, and quite courageous with respect to other dogs; however, whenever a fly would alight nearby, he would jump to his feet, show "airplane" ears, pant, and seek human contact for security.

Socialization Deficits

Another common source of fearfulness stemming from puppyhood is the result of inadequate socialization and environmental exposure during appropriate sensitive periods in a puppy's development. Puppies raised in isolation from human contact become progressively fearful of human contact. Freedman and colleagues (1961) found that puppies raised in isolation until they were 3 weeks old tended to approach human handlers immediately. If not exposed to people until 7 weeks of age, however, isolated puppies began to show greater aversion and avoidance, taking an average of 2 days to finally approach a passive handler. By 14 weeks of age, the puppies who had not been previously exposed to human contact were extremely and persistently fearful toward people and made no contact with the passive handler (see *The "Critical" or Sensitive Period Hypothesis* in Volume 1, Chapter 2).

The Role of Abuse

Fear of human contact and other bizarre avoidance behavior can sometimes be traced back to abusive handling and mistreatment, although appeal to abuse as a cause of fear may be somewhat inflated (Lockwood, 1997). Potential adopters are often informed by shelter workers that a prospective adoptee had been abused, especially if the dog in question exhibits a behavior problem associated with nervousness or fear. Such unverifiable information may be based on an erroneous generalization that fearful behavior is prima facie evidence that a dog has been abused or neglected. Undoubtedly, physical and emotional abuse occurs and may be a significant cause of fear; however, it probably occurs far less often than one might expect from the frequency of such reports.

Major: A Thunder-phobic Dog

A common source of fearful behavior in dogs is loud noises. Such fears are subject to threshold modulation as the result of safe exposure (habituation) or traumatic exposure (sensitization). Dogs that are repeatedly and safely exposed to loud noises will usually learn to cope by ignoring or tolerating their occurrence. However, if a loud noise is presented in a particularly aversive or threatening manner, especially if it occurs in conjunction with noxious stimulation, a lasting alteration of fear thresholds involving loud noises may occur. In some cases, following traumatic aversive stimulation, fear thresholds may be permanently lowered, possibly resulting in the development of a phobia. Hothersall and Tuber (1979) describe a case that dramatically exemplifies the sensitizing effects of traumatic exposure to loud noise and its role in the development of fearful behavior. The dog was a 4½-year-old Labrador retriever named Major. Up until 6 months of age, Major showed no signs of fear toward loud noises such as thunder or gunshots. The owner was an avid hunter who took the dog along into the field, where he had shot his gun directly over the dog's head without producing any apparent signs of fear. The dog's confidence toward loud noises was shattered, however, as the result of an accidental explosion. The single experience was enough to permanently alter the dog's fear threshold for loud noises:

> At the age of six months, Major was chained to a bench in a body shop while his owner did some welding work. The 220-V cable to an air compressor shorted out causing an arc welder to explode with a loud bang and a flash of light. Since that one experience Major has been afraid of loud noises, storms, and gunshots. His reaction to a storm consisted of panting, shaking, constant seeking of attention, profuse salivation, and vigorous attempts to escape from the storm. Tranquilizers had no effect upon this reaction, which the owner reported would carry over the day after the storm. (246)

Major's heightened fear of loud noises probably was the result of traumatic sensitization. Sensitization in this case was particularly dramatic, generalized, and lasting (resistant to habituation), possibly because of the combined influences of event-situational unfamiliarity and an innate fear-expectancy bias facilitating the association of fear with loud sounds and sudden movements. The resulting hypervigilance and generalized fearful arousal toward other loud noises (e.g., thunder) are

consistent with such an interpretation. Being chained at the time of the explosion may have made the situation even more traumatic. The condition of restraint took away the dog's ability to control the event effectively or reduce its aversiveness by escaping. Essentially, the event was both unexpected (unpredictable) and inescapable, providing the cognitive conditions conducive for the development of lasting and generalized fear [see *Post-traumatic Stress Disorder (PTSD)* in Volume 1, Chapter 9].

Another interpretation, based on the traumatic disconfirmation of safety, is also possible. Just as a threat is anticipated by various predictive signals, safety is also associated with signals (i.e., signals that predict the absence of danger). These combined signals form the contextual framework for determining whether a threatening event is likely to occur or not. The expectancy of safety usually interferes with aversive conditioning and sensitization; that is, the dog is biased with respect to the significance of potentially aversive events—they are perceived as being less of a threat. However, under the influence of a particularly traumatic and inescapable event, as in Major's case, such expectancies, previously mediated by familiarity and safety (that is, the absence of aversive stimulation), may be suddenly disconfirmed. Consequently, in the future, signals associated with safety may not be viewed with as much confidence and reliability as they were prior to the trauma. In fact, some safety signals immediately preceding the traumatic event may be counterconditioned into predictors of aversive stimulation.

Given that Major was familiar with the workshop situation and felt safe while in it, the traumatic event may have produced a dramatic and generalized disconfirmation of *safety,* which consequently extended to other situations that he also regarded as being safe. As a result of traumatic exposure to loud noises occurring under the contrary expectancy of safety, feelings of safety may come to predict potential danger. When in other situations previously associated with safety (e.g., while at home), the occurrence of loud noises may dramatically lower fear thresholds. Finally, affects associated with safety and relaxation may not only be disconfirmed but may have been directly paired with the intense fear elicited by the explosion. As a result, instead of predicting continued safety, such internal *safety* cues may come to predict the possibility of danger, preparing a dog emotionally to anticipate a threat. As a result, whenever the dog feels safe in the future, he may inexorably become anxious and vigilant.

A third possibility should also be considered. Even if the environment was familiar to the dog, its safety may have been momentarily compromised by various local events altering the dog's sensitivity to aversive stimulation. While restrained and subjected to the sound of tools and other forms of mild aversive stimulation going on nearby, the dog may have been motivationally put on edge and rendered more sensitive and reactive to the fear elicited by the explosion. These sorts of ambient aversive stimuli may reduce the benefit of safety expectancies normally associated with a familiar environment. Safety expectancies appear to "immunize" the dog against adverse fear reactions by interfering with aversive emotional conditioning. Finally, fear elicited by the explosion may have been added to fear elicited by ambient stimulation, thus producing an additive effect on the dog's level of fear.

Expectancy Bias

Expectancy bias appears to play a major role in the learning of fear. Positive (safety) and negative (fear) expectancy biases influence a dog's perception of the environment and mediate the formation of various preferences and aversions. Many social and place preferences appear to be acquired early on in a puppy's development, with social biases being strongly influenced by attachment and bonding processes (Scott and Fuller, 1965). For example, dogs that have been socialized exclusively with humans may form a very persistent and negative expectancy about contact with other dogs. Such dogs will likely show an equally strong, but opposite, positive expectancy about contacts with people. Similarly, limited environmental exposure, especially early in a puppy's life, will likely result in the dog becoming fearful of new places as an adult.

Bias Toward the Strange and Unfamiliar

Social and place fear-expectancy biases may extend from a biological preference for the *familiar* and aversion for the *unfamiliar.* Most dogs show divergent expectancy biases toward situations and events depending on how familiar they are with them. A familiar situation is normally perceived in advance as probably being more safe than an unfamiliar one. Unfamiliar things are often viewed with suspicion. Unfamiliar situations are approached more warily simply because it is not known whether they are safe or dangerous beforehand. Dogs tend to expect more positive things to occur in the presence of familiar people and situations. Unfamiliar people and situations may be approached with greater caution, since such encounters may present opportunity as well as danger, but one cannot know for sure in advance.

In the *Republic,* Plato (Hamilton and Cairns, 1961) viewed this canine trait as a mark of wisdom:

> This too, said I, is something that you will discover in dogs and which is worth our wonder in the creature.
>
> What?
>
> That the sight of an unknown person angers him before he has suffered any injury, but an acquaintance he will fawn upon though he has never received any kindness from him. Have you never marveled at that?
>
> I never paid any attention to the matter before now, but that he acts in some such way is obvious.
>
> But surely that is an exquisite trait of his nature and one that shows a true love of wisdom.
>
> In what respect?
>
> In respect, said I, that he distinguishes a friendly from a hostile aspect by nothing save his apprehension of the one and his failure to recognize the other. (622)

The apparent preference for the familiar and aversion for the unfamiliar may adversely bias dogs against strangers (xenophobia) and novelty (neophobia). A significant implication of familiar/unfamiliar biasing is that it may cause unfamiliar persons, places, and things to be more easily associated with fear than are familiar persons, places, and things. Aversive stimulation may result in greater fear conditioning and slower extinction when it occurs in an unfamiliar situation than if the same stimulation takes place in a familiar one. The greatest potential for adverse fear conditioning is likely to occur toward an unfamiliar event (stimulus bias) in an unfamiliar situation (context bias).

The preference for the familiar and aversion for the unfamiliar undergoes ontogenetic modification as a puppy develops. Initially, puppies are biased to maintain contact with the familiar and to avoid the unfamiliar, that is, the world existing beyond the mother, other littermates, and the immediate nesting area. As puppies mature, the familiar becomes a staging platform for exploring and exploiting the unfamiliar for the benefit of their survival. Although the unknown represents an inherent risk, it is also a source of tremendous opportunity. Whereas fearful dogs withdraw from the unfamiliar because of the potential risk it represents, confident and secure dogs are attracted to the unfamiliar because of the potential opportunities it offers. The acquisition of a fearful expectancy bias toward the unfamiliar is probably influenced by the quality and quantity of early experiences with new things, social contacts with unfamiliar people and dogs, and exposure to novel places. Puppies that learn to anticipate beneficial outcomes in association with unfamiliar situations will be more likely to view such situations as a source of opportunity rather than perceiving them as a potential threat.

Exposure to varied situations involving familiar and unfamiliar stimulation in combination with human handling appears to be highly beneficial for developing puppies. Human handling, beginning as early as 5 weeks of age, appears to help puppies develop a more confident and curious attitude toward novelty (Wright, 1983). Early social handling and exposure to novelty take advantage of a puppy's less wary and more indiscriminate approach tendencies. The strange and unfamiliar are approached through the agency of curiosity and play. These early tendencies gradually give way to growing levels of fear and the decline of playful social tendencies and exploratory curiosity. It is not surprising that overly fearful dogs typically exhibit significant deficits in both areas. Puppies appear to be particularly recep-

tive to exploring the wider environment at about 12 weeks of age, when they begin to leave the familiar surroundings of the nesting area to make more bold excursion into the surrounding environment. However, puppies that are exposed to a traumatic experience during a sortie into an unfamiliar situation might be doubly affected by the experience, (1) developing a persistent fear of the event associated with aversive stimulation and (2) becoming more wary of unfamiliar situations in the future.

Bias Toward Loud Sounds and Sudden Movements

Loud sounds and sudden movements may be influenced by an expectancy bias, making fearful conditioning toward loud sounds or sudden movements much more rapid and permanent. Also, the threshold for fearful auditory stimulation appears to be highly responsive to sensitization, and once sensitization has occurred, the resulting increased sensitivity to the eliciting stimulus may be very resistant to habituation. Many common phobias involve sudden and loud auditory stimulation (e.g., thunder fears). Also, dogs are often nervous around noisy traffic, a situation containing a variety of startling sounds and sudden movements that may be inherently aversive. Under natural conditions, the possession of low thresholds for startling sounds and sudden movements would provide a valuable defense against many potential threats, including social ones—both loud sounds and sudden movements are present in assertive threat displays. Puppies are responsive to both forms of startling stimulation from an early age onward. Initially, puppies appear to respond to such stimulation with indiscriminant startle and fear but gradually learn to respond more selectively and adaptively. Failure to provide early exposure and opportunities to learn about the significance of loud sounds and sudden movements may cause the underlying fear bias toward them to become more pronounced, generalized, and maladaptive.

Social and Sexual Biases

Many anecdotal reports and some bits of scientific evidence suggest that dogs may exhibit differential biases toward people, based on something like *social chemistry.* Gantt and colleagues (1966), for example, observed that some people are inherently more attractive and calming to dogs, whereas others appear to be inherently more aversive and agitating. Some evidence of sex-biased preferences and aversions has also been reported. Lore and Eisenberg (1986) performed a series of social approach tests indicating that male dogs tended to approach female handlers more readily than they approached male handlers. Female dogs did not exhibit a significant bias based on the sex of the handler. Wells and Hepper (1998) have found that shelter dogs (both male and female) are more defensive-aggressive toward men than women. Perhaps one result of the male dog's preference for women is that he is more prepared to associate affection selectively with women than with men. Conversely, such a bias may cause fear to be more easily associated with men than with women.

Prediction and Control

Predictive Information and Safety

As already discussed, event predictability and controllability play very significant roles in the learning and unlearning of fear. Predictive information is provided by both the occurrence and the nonoccurrence of aversive conditioned stimuli. Such conditioned stimuli provide predictive information about the occurrence (threat) and nonoccurrence (safety) of unconditioned aversive events. Predicted aversive events are preferred over unpredicted aversive events. A well-predicted threat renders its occurrence more controllable and, perhaps, less aversive by giving animals a chance to prepare for its occurrence. However, the absence of a some fear-eliciting CS is also predictive; that is, its omission predicts safety from the occurrence of the threatening US. For example, thunder-phobic dogs may readily learn to anticipate the occurrence of storm activity by the occurrence of various weather-related changes, such as a sharp drop in barometric pressure, the appearance of overcast skies, or humidity changes. These various meteorologic events have occurred in

the past in advance of storm activity and may evoke anticipatory anxiety in thunder-phobic dogs. In fact, many dogs show signs of distress long before any evidence of thunder or lightning appears. The absence of such signals is also informative to dogs; that is, the absence indicates that a storm is not likely to occur. In other words, the absence of barometric change and other related weather indicators predict safety from the threat of storm activity.

Wolpe (1958) performed an experiment demonstrating the safety-signal hypothesis by using an auditory signal. A cat was first trained to approach a food container and eat whenever a buzzer was sounded. Once this training was well established, a second phase of the experiment was carried out. Food pellets were placed in the container, but, now, if the cat approached the container in the absence of the buzzer, it was administered a mild shock. After a brief period of adjustment and training, the cat discovered that it was safe to eat only when the buzzer preceded the presentation of food. As the result of such conditioning, the omission of the buzzer had become equally significant as its presentation; that is, the cat learned that the buzzer's omission predicted a period when shock would result if it attempted to eat from the container. Safety signals are very useful for managing and controlling fear in dogs.

Socialization and Training

To help dogs develop a confident attitude toward people, other dogs, places, and things, they must be provided with adequately diverse and orderly training activities. The provision of training and exposure assures dogs that their surroundings are highly predictable and controllable. When there exists a lack of agreement between what dogs expect and what in fact occurs, varying degrees of psychological distress, worry, doubt, and insecurity may ensue. When such events are of a highly aversive quality, generalized anxiety and chronic stress may result. Many dogs are exposed to a daily "ritual of confusion" in which punishment is presented on a noncontingent basis. Under the adverse influence of such conditions, a variety of anxiety-related behavior problems are prone to develop (see *Learning and Behavioral Disturbances* in Volume 1, Chapter 10). Of particular significance in this regard, is the risk of maladaptive cross-association of fear and anger. Under normal conditions, fear modulates aggression, but when fear and anger become conjoined by chronic anxiety and frustrative arousal, a maladaptive outcome is prone to occur in the form of intractable vigilance and low-threshold aggression.

Failure to provide a dog with orderly (that is, highly predictable and controllable) socialization and training activities may incline it to perceive its owner's actions as being undependable or irrelevant. Such adverse assessments of the owner's competence may cause the dog to ignore the owner. This sort of situation is undesirable in any case but is especially detrimental in the case of a fearful or insecure dog, which may depend on its owner for guidance and security. A fearful dog needs a competent leader to take charge. Without its owner's help, an insecure dog may become progressively fearful under the influence of an expectation of failure when confronting threatening or unfamiliar situations. As will be discussed momentarily, fearful or insecure dogs appear to *expect to fail* in their efforts to control potentially threatening situations.

A dog's confidence in its owner (and by extension the rest of the world) is first and foremost the result of its collective and first-hand impressions of its owner's competence as a trainer and leader. If a dog is not suitably impressed by its "master's" training abilities and intelligence as a leader, it will never believe that its owner is capable of safely managing a potentially dangerous world.

EFFICACY EXPECTANCIES

Fear is an adaptive response to the extent that it motivationally prepares dogs for appropriate action in the face of threatening situations. Whether or not fear becomes problematic or maladaptive depends on a number of interrelated behavioral, cognitive, and physiological factors. As already pointed out, a great deal hinges on whether a dog believes that it can succeed in its efforts to predict and control threatening events (Bandura, 1977). Efficacy

expectancies or "beliefs" are based on past experiences with both appetitive and aversive events (see *Locus of Control and Self-efficacy* in Volume 1, Chapter 9). These expectancies are influenced by learning in at least three specific ways: (1) learning what to do and when to do it, (2) learning what outcomes to expect as the result of appropriate action, and (3) learning that one is *able* to perform the required action.

Expectancy Confirmation and Disconfirmation

Efficacious action is purposive, that is, goal directed. Since the occurrence of discriminative stimuli (S), the responses (R) required, and the various outcomes (O) produced by those actions are not present in the same moment of time, but rather distributed over the course of time, the animal must necessarily form some neural or cognitive representation of how these various events are related. The events (S-R-O) and the various expectancies derived from them provide the cognitive foundation for effective action. *All organized voluntary behavior is based on assumptions and predictions (expectancies) that are differentially confirmed (reinforced) or disconfirmed (extinguished) by the outcomes they produce.*

Behavior is organized into a purposive train of events according to accumulated S-R-O expectancies formed as the result of past experience (in the sense of the Latin *experiri,* "to try out"). When a dog acts, it does so with the intention of producing some effect, if only to move its body from one location to another. Since the intended outcome does not actually exist before the action occurs, the relation between the response and outcome is necessarily mediated by some neural representation or expectancy. The intended or hoped-for outcome is only one of many possibilities that might occur, however. Since something might occur other than the intended outcome, the actual outcome must somehow be compared with the intended outcome (comparator function). The recognition of success (expectancy confirmed) is associated with various collateral effects such as feelings of elation (reward), whereas the recognition of failure (expectancy disconfirmed) is associated with disappointment (punishment). In general, the concomitant affect associated with purposive behavior is *hope* (see *Instrumental Learning* in Volume 1, Chapter 7).

Intention and Purpose

Intention is a generalized purpose-setting cognition. In obedience training, the intention corresponds to a dog's cognition of a command (discriminative stimulus) and the various emotional and motivational responses elicited by the command (conditioned establishing operations). Under natural conditions, the intention is cued by some sign triggering underlying emotional and motivational incentives to act. The intention behind an action has direct bearing on whether the consequences produced by the action will be reinforcing or punishing. For example, one intention of aggression is to force an actual or perceived threat to retreat or submit. If the behavior succeeds in achieving the intended goal (e.g., the rival runs way), it is reinforced. On the other hand, if the behavior fails to achieve its intended goal (e.g., the aggressor is displaced or defeated), the behavior is punished. In both cases, new expectancies are formed with respect to aggression occurring under similar circumstances in the future.

Expectancy and Reinforcement

Purposive actions are expected to work. Consequently, when the result of some action exactly matches an animal's expectancy, the latter is confirmed and no additional learning is necessary (asymptote). Although further learning may not occur as the result of repeated confirmations of an expected result, the animal's sense of well-being and confidence may be enhanced by such repeated success. Additional learning and adjustment occur only if the outcome fails to match (disconfirms) the operative expectancy in one of two ways: (1) The behavior either fails to obtain the intended outcome, or the outcome obtained is less than expected (disappointment). Such behavior is modified until it either succeeds (trial and *success*) or, if the behavior continues to fail, as hope is constrained by disappointment, the ineffectual

behavior is gradually extinguished. (2) The behavior produces an outcome in excess of the one expected (surprise). Behavior associated with surprise is adjusted to maximize control over an unexpected opportunity. The adjustment of expectancies helps animals to fit their behavior more accurately to the surrounding environment.

Dysfunctional Expectancies

People and animals do not set out intentionally to fail, or continue to persist in a course of behavior that is hopeless, unless they happen to be neurotic. There are two general ways in which behavior becomes maladaptive or dysfunctional: (1) The behavior operates independently of purposive regulation (e.g., compulsion). (2) The behavior is emitted without an expectation of success (e.g., helplessness). In the first case, the intention and expectancy functions guiding purposive behavior may be operational, but the animal is unable to act in accordance with them. Excessively fearful dogs, for example, may properly seek safety from some threatening situation, but finding that the strategy does not work, they may nonetheless persist in the ineffectual behavior—even though they know that it will fail! *Expecting to fail in the presence of a threat is a potent source of fear and generalized anxiety.* The expectation of failure in the presence of a threat results in escalating fear, disorganized panic, and hopelessness. On the other hand, an *expectancy of success* facilitates confident and organized behavior while simultaneously modulating and constraining collateral aversive emotional arousal. Dogs that believe (a highly confirmed expectancy of success) that they will succeed are better prepared to cope with the various threats and challenges presented by the social and physical environment.

Externals and Internals

Another influential efficacy factor present in the development of persistent generalized anxiety and phobias should be considered before leaving the topic of efficacy expectancies. Rotter (1966) notes that individuals can be divided into two types of learners, depending on where they localize the locus of control over significant events. Learners who believe that control over important events is located outside of themselves (externals) are prone to expect that their efforts will fail (pessimistic attributional style), and even when they happen to succeed, they may still attribute their success to factors outside of their control. In contrast, learners who locate the locus of control within themselves (internals) are more likely to expect to succeed and to attribute their success to their own efforts (optimistic attributional style). Fearful or excessively anxious dogs are much more likely to be *external* learners. Only through appropriate training can overly fearful dogs learn that they can control external events. By *internalizing* the locus of control, dogs can eventually learn how to cope with threatening events more constructively. However, by believing that events are outside of their influence, dogs will continue to be controlled by their fears and never shake their pessimistic expectancies regarding them.

The ability of dogs to behave adaptively is not possible unless they have some idea of what to do and what to expect as a result of what they do. However, it is not enough for a dog to know these things, unless it also possesses the necessary confidence and ability to perform the required actions. A dog's degree of confidence reflects its accumulated past successes and failures. Adaptive learners expect to succeed (hopeful), whereas maladaptive learners expect to fail (hopeless). Adaptive learning promotes confidence, well-being, and an elated mood, whereas maladaptive learning saddles dogs with apprehensiveness, worry, insecurity, and generalized anxiety. Dogs that generally *expect to fail* are constrained to exist in a small corner of life where they feel most secure and likely to succeed. Dogs that expect to fail when threatened may experience unfamiliar situations and people as powerful sources of fear. Furthermore, the potential opportunities associated with the unfamiliar are not much solace for such dogs, since they are often equally inclined to expect to fail when it comes to appetitive resources, as well. Efficacy beliefs are especially influential under adverse motivational circumstances. These considerations have tremendous relevance for

the management and control of behavior problems associated with fear, anxiety, frustration, and anger.

Primal Sensory Modalities Mediating Attraction and Aversion

Touch

The sense of touch is the most primitive sensory modality mediating attraction and aversion (see *Effects of Touch* in Volume 1, Chapter 4). Touch contact with the environment gives a dog hedonic (pleasure-pain) information about stimuli acting directly on its body. Most of what is regarded or interpreted as emotional appears to be derived from information coming from the sense of touch. Touch plays a central role in the mediation of affectionate bonding and its maintenance. Higher touch analyzers interpret tactile stimulation in terms of the primal hedonic opposites of pleasure and pain. Events and situations that are either emotionally attractive or aversive are often directly or indirectly (i.e., through conditioning or generalization) linked to past experiences with touch. If born without functional touch sensitivities, dogs would be rendered insensitive, insular, and lack the ability to interpret events emotionally. Dogs that are hypersensitive to touch are more likely to be adversely affected by fear and anxiety stemming from aversive stimulation. Through the mediation of touch, animals acquire a complex range of interpretive feelings and expectations about the persons, places, and events with which they come into close contact. In addition, the accumulated experiences of touch are codified in an animal's mood and general attitude about contact with the social and physical environment. Early experiences with touch are particularly influential since they set the emotional tone and expectancy of puppies, biasing them in a positive or negative direction with respect to how they interpret close social contact as adults.

Olfaction and Emotional Learning

The role of olfaction in emotional learning is often neglected. This neglect is probably a result of the comparatively minor role that olfaction plays in the human perceptual *Merkwelt,* a perceptual organization that places much less value on olfaction than, for example, sight and hearing. In dogs, olfactory abilities are highly developed and play an important role in social learning and sexual behavior. Olfaction, in conjunction with subtle tactile and thermal learning, appears to play a vital role in the development of early preferences and aversions (Rosenblatt, 1983) (see *Social Comfort Seeking and Distress* in Chapter 4). According to this view, early neonatal ontogenesis progresses from tactile searching and contact, to detecting and following thermal gradients, to olfactory information derived from the wider environment. Olfaction is the most primitive of various sensory means for seeking and identifying significant stimuli occurring beyond immediate touch and thermal sensations. As an animal develops, additional sensory abilities are integrated for the purpose of scanning an even wider environment and, in conjunction with developing cognitive abilities, the ability to predict and control the occurrence of significant events. Consequently, it is reasonable to believe that olfactory signals are preferentially linked with information produced by appetitive, tactile, and thermal stimulation.

The olfactory tracts project directly into areas of the limbic system that are closely associated with emotional and social learning, potentially making olfaction an ideal sensory modality for counterconditioning fears and aggressiveness. Olfactory information is readily conditioned to produce lasting avoidance behavior when contingently associated with aversive or startling events. Conversely, associations between olfactory signals and appetitive or relaxing events can also be readily established. Olfaction appears to mediate conditioning of what Pavlov called the *social reflex.* Pavlov (1928) observed that dogs selectively responded to the presence of different people in his laboratory, based largely on the quality of their previous experience with them. This observation alone is not terribly interesting, but what he subsequently discovered clearly underscores the significance of olfaction for social learning and conditioning. He found that a particular experimenter had a habit of

closely and affectionately interacting with one of the dogs under his care. As a result, the dog became closely attached to the experimenter and exhibited a strong conditioned social response whenever the individual entered the room. An experiment was performed to determine how much of this conditioned social response was controlled by the experimenter's scent or by other sensory stimuli. This was accomplished by placing the experimenter's clothes in the room where the dog had been confined and observing the dog's behavior. The experimenter's scent alone produced a similar (although diminished) social response in the dog as observed when the experimenter was actually present in the room with the dog [see Pavlov (1928:368) and Gantt et al. (1966)].

PLAY AND FEAR

Panksepp and colleagues (1984) argue that specific circuits in the brain are uniquely dedicated to the elaboration and expression of play. These play circuits are highly sensitive to the modulatory influences of fear, aggression, and nutritional deprivation. Fear and irritability appear to inhibit play directly, making the absence of play a possible diagnostic indicator of fear and aggression. The researchers found that lesioning of the ventromedial hypothalamus (VMH) produces pronounced effects on an animal's disposition to play. Presumably such lesions disrupt play by lowering irritability thresholds in response to playful gestures and initiatives:

> When these VMH lesioned pups [rats] were paired with controls who initially responded with playful solicitation, the VMH lesioned animal seemed unable to reciprocate. Playful gestures provoked defensive biting, and the controls shied away from further interaction. It was as if the VMH pups were unable to correctly interpret the playful gestures. Such results suggest that continuance of vigorous play requires active inhibition of irritability. Thus, it might be hypothesized that the medial hypothalamus normally promotes play by inhibiting aggressive tendencies which may periodically emerge during rough-and-tumble activities. (478)

These findings suggest that the continuation of play depends on the relative absence of fear and irritability. Play itself appears to exercise a modulatory effect on both fear and aggression, perhaps with the help of various species-typical signals that modulate nervous arousal. However, the modulatory effects of play may be rapidly overshadowed by increasing levels of fear or anger. The inhibitory effects exerted by fear and anger over play are much stronger than the pacifying effects of play on fearful or aggressive arousal. Play and fear are motivationally antagonistic toward each other, but play is probably organized at a higher cortical level. Like other cortical functions (e.g., attention and impulse control), play's relation to limbic and autonomic arousal is asymmetrical—fear asserts a stronger influence over play than play asserts over fear.

Playful dogs are normally social extroverts exhibiting a strong willingness to initiate social contacts and to explore unfamiliar environments. Socially inhibited dogs, on the other hand, are usually introverts that are prone to be withdrawn, reserved, and suspicious when confronted with unfamiliar situations or social contacts. In cases where a very low fear threshold exists, introverted dogs may avoid all social contact outside of their immediate circle of familiar contacts. Such dogs are prone to form an intense compensatory attachment to the owner or other family members. They are prone to run away and hide if threatened, unless escape is blocked. If escape is prevented and the threat increased, such dogs may attack to get away. Finally, introverted dogs with low thresholds for aggression and fear (sharp/shy) are prone to exhibit fight-flight conflict behavior and may bite under stressful conditions. Under normal circumstances fear arousal regulates the expression of aggression through direct inhibition, but in some cases fear may actually facilitate the expression of aggression as an escape/avoidance response (see *Fear and Aggression* in Chapter 7). In the case of the dominance aggression, perhaps the behavioral threshold controlling aggression (fight) is reached before the threshold of inhibitory fear (freeze-flight) is reached.

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4

Attachment, Separation, and Related Problems

Genuine social contact requires distance, and not only in a metaphorical sense.

PAUL LEYHAUSEN, *"On the Natural History of Fear"* (1973)

PART 1: ATTACHMENT AND SEPARATION

ATTACHMENT AND SEPARATION DISTRESS

Social and place attachments owe their development to a puppy's strongly motivated desire to maintain close contact with its mother and to stay within the safe confines of a familiar home area or nesting site. The importance of social and place attachments for dogs can be readily and dramatically demonstrated by taking a puppy away from its mother and

confining it to an unfamiliar place. Such isolation invariably elicits robust signs of heightened emotional distress, sustained vocalization, and vigorous efforts to regain contact with the mother and littermates (see *Social Attachment and Separation* in Volume 1, Chapter 3). These species-typical responses to separation are commonly observed by puppy owners and have been carefully studied in the laboratory (Scott et al., 1973).

Separation distress probably reflects an evolutionary adaptation to the dangers of being left alone, with distress reactions discouraging vulnerable puppies from wandering too far away from the safety of the lair. In addition to prompting her to locate puppies that have wandered too far away, separation-distress vocalizations (whining and yelping) may stimulate the mother to stay close by her young, at least until they are old enough to fend for themselves. Young animals that express this tendency are much less likely to fall victim to various natural calamities and, therefore, are more likely to reproduce successfully and perpetuate the genes mediating the trait. In testament to its evolutionary value, separation distress enjoys a significant evolutionary continuity among animals, with a wide variety of species exhibiting the tendency.

The enhanced contact and safety secured by distress calls not only increase a puppy's survivability, they also provide the emotional basis for the formation of lasting social relationships. Behaviorally speaking, separation distress functions as an *establishing operation* under the motivational influence of which distance-decreasing behavior is emitted by both the infant and the mother. In addition, as the result of relief from distress, distance-decreasing or contact-seeking behavior is strongly reinforced when contact between the mother and infant is restored. Animals that exhibit separation distress as young tend to maintain close social contact with one another as adults. From this perspective, adult attachment and bonding tendencies may be viewed as secondary elaborations built upon the distress-relief exchanges first occurring between the mother, the infant, and littermates.

Given such emotional exchange and dependency, it is natural to expect that some degree of lasting mutual attraction and affection should develop between the vulnerable infant, its mother, familiar conspecifics, and others providing comfort and care to the puppy. In fact, Peter Hepper (1994) demonstrated that offspring recognize the scent of their mother and the mother recognizes the scent of her offspring after 2 years of continuous separation starting at 8 to 12 weeks of age. William Carr and colleagues at Beaver College (Glenside, Pennsylvania) extended Hepper's research, showing that dogs recognize the scent of their mothers after 6 years and, possibly, as long as 10 years after separation. Interestingly, with respect to the durability of the social bond, they found that dogs could recognize the hand scent of the breeder for 4 years and possibly as long as 9 years after separation without any intervening contact (Appel et al., 1999). Essentially, these findings suggest that olfactory memory and social recognition are lifelong in dogs.

BOWLBY'S SOCIAL BOND THEORY

John Bowlby (1969, 1973) made many pioneering contributions to the study of attachment and separation-related behavior. Originally trained as a psychoanalyst, Bowlby had broad philosophical and scientific interests, including a combined appreciation of ethology and behaviorism. According to Bowlby's eclectic theory, separation distress is mediated by primitive, self-protective impulses to maintain close contact with the mother. He adopted a Darwinian perspective on separation distress, interpreting it as an ontogenetically adaptive response to imminent danger resulting from maternal separation and isolation.

Bowlby (1969) describes several developmental phases that infants undergo during the ontogeny of attachment. Phase 1 involves the display of bodily orientations and various signals, but the exchange lacks social specificity. Phase 2 also involves the display of bodily orientations and the exchange of signals but with evidence of a progressive preference being exhibited toward primary attachment objects. Phase 3 involves bodily orientation, signals, and locomotion in an effort to maintain proximity with the attachment object. The infant shows heightened arousal at times of separation and becomes more excited when reunited

with the attachment object. During phase 3, the infant begins to use the attachment object as a security base for environmental exploration. Also, during this phase, the infant becomes more selective with regard to social contacts and may exhibit increased alarm and caution when approached by a stranger. Phase 4 involves the development of a more complex cognitive understanding of the attachment object as an independent entity or partner. With regard to human infants, at approximately 3 years of age, children may begin to appreciate their mother as having personal feelings and motives of her own, laying the foundation for a much more complex and empathetic relationship or what Bowlby calls a *partnership*.

Protest, Despair, and Detachment

Bowlby observed a regular sequence of events that infants go through when they are separated from an attachment object. These responses to separation include protest, despair, and detachment. The *protest* phase involves general arousal and behavioral activation, with loud vocalizations, disruptive behaviors, and searching activities aimed are regaining contact with the absent mother. Protest and increased general activity occur immediately after the mother departs and corresponds in many ways to the sorts of behavior associated with separation distress in dogs (Voith and Borchelt, 1985; Lund and Jorgensen, 1999). *Despair,* the depressive phase, is associated with depressed affect and mood, inactivity, and infrequent distress vocalizations; however, even though depressed, the infant still remains vigilant for the mother's return. Finally, the third phase, *detachment,* involves an apparent loss of interest in the mother when reunited with her. All of these various phases of separation distress appear to present in various forms in dogs, suggesting that dogs and humans share similar emotional substrates for mediating the expression of separation-elicited behavior. In addition to mediating both human and dog separation distress, these shared substrates probably provide the framework for humans and dogs to form lasting attachments with one another.

Attachment and Fear

According to Bowlby, the attachment object provides support and security to the infant for a wider exploration of the environment (Mineka and Suomi, 1978). With the security of the mother's protection nearby, an infant can more confidently venture away from the immediate nesting area and explore its surroundings, at least until it encounters a threatening situation. When frightened, immature animals tend to flee back to the security of their mother, thus simultaneously reducing fear while enhancing social attachment. In fearful situations where the attachment object is absent, an infant's sense of security may be undermined and its ability to modulate fearful arousal compromised. In the absence of the mother, thresholds for fear and separation distress may be significantly lowered, resulting in highly aversive and generalized fear and panic toward the environment (Harlow and Mears, 1979). As the result of traumatic experiences during separation, animals may learn to fear being left alone and exhibit signs of anticipatory anxiety at times when they expect to be separated. As a result, sensitized animals may develop an anxious or anaclitic attachment, with increased vigilance about their mother's whereabouts, as well as exhibiting increased efforts to maintain close proximity with her.

The concurrent arousal of fear and separation distress may account for many characteristic patterns of behavior exhibited by separation-reactive dogs. One hypothesis derived from Bowlby's account is that adult separation anxiety may be incubated out of early experiences in which intense fear is elicited without the presence of an attachment object to help modulate fearful arousal and restore emotional equilibrium. Such animals may develop a fear of separation, thereby amplifying separation distress while coactively lowering fear thresholds when left alone. Consequently, at separation both fear and separation distress interact in a synergistic and mutually escalating manner that results in the expression of fear-related separation behavior. According to this analysis, separation anxiety is a state of emotional arousal that combines separation distress with a fear of separation. Consistent with this interpretation,

many dogs exhibiting phobias also exhibit secondary separation-anxiety problems. These observations suggest that separation-related problems have a complex etiology, with fear being a significant factor in some cases (especially in dogs with existing phobias), but certainly not all dogs exhibiting separation-related problems do so because of fear.

PSYCHOBIOLOGICAL ATTUNEMENT: THE BIOREGULATORY HYPOTHESIS

The withdrawal of an attachment object appears to exert numerous psychobiological effects, the sum of which produce disruptive emotional and physiological distress in a separated animal. Adopting this line of analysis, M. A. Hofer (1983) argues that attachment is mediated by the establishment of various maternal regulatory influences over biological processes and needs exhibited by the infant. When the attachment object is withdrawn, these modulatory influences are disrupted, and the young animal is caused to experience acute distress. According to the bioregulatory hypothesis, separation anxiety is the result of biological stress produced by the loss of maternal regulatory influences over physiological processes. Similarly, Tiffany Fields (1985) has proposed that various reciprocal interorganismic regulatory influences are instrumental in the formation of attachments occurring at various points in an animal's life cycle, including, but not limited to, the mother-infant relationship. She argues that separation distress is not due to a disruption of an hypothesized *attachment* bond between mother and infant, but rather distress results when the psychobiological synchrony or *attunement* between mutually attached organisms is disrupted by separation:

> Attachment might instead be viewed as a relationship that develops between two or more organisms as their behavioral and physiological systems become attuned to each other. Each partner provides meaningful stimulation for the other and has a modulating influence on the other's arousal level. The relationship facilitates an optimal growth state that is threatened by changes in the individuals or their relationship or by separation and the behavioral and physiological disorganization that ensue. Thus, attachments are psychobiologically adaptive for the organization, equilibrium and growth of the organism. Because the organism's behavior repertoire, physiological makeup, and growth needs are an integrated multivariate complex that changes developmentally, multiple and different types of attachment are experienced across the life span. (15–16)

The psychobiological attunement hypothesis of attachment and separation distress is compelling. Dogs often exhibit their first acute episodes of adult separation anxiety following prolonged contact with the owner. Also, the disruptive events associated with separation are particularly common after long vacations or after an owner returns to work or school after a long stay at home. Theoretically, some dogs may undergo enhanced regulatory synchronization with the owner during these periods of prolonged contact. The sense of well-being achieved during these periods of prolonged contact is dramatically disrupted when a dog is separated from its owner, with the resultant evocation of separation-related disturbances and excesses.

OPPONENT-PROCESS THEORY AND SEPARATION DISTRESS

The opponent-process theory (Solomon and Corbit, 1974) may offer a useful construct for understanding certain etiological aspects of adverse separation reactivity in dogs (see *Practical Application of Opponent-process Theory* in Volume 1, Chapter 5). According to this theory, there exists a hypothetical neural system that regulates emotional arousal and prevents affective extremes from occurring as the result of attractive or aversive stimulation. This emotional regulatory function is believed to be performed by indirect and hedonically opposite *slave* emotions that shadow attractive and aversive stimulation. These underlying slave emotions serve to dampen affective extremes. For example, while being petted, a dog experiences a wide range of socially comforting emotions or *a-processes.* The opponent-process theory postulates that such feelings of well-being and comfort are shadowed by hedonically opposite affects (e.g., feelings of contact need) or *b-processes.* The antagonistic b-processes are of an opposite hedonic

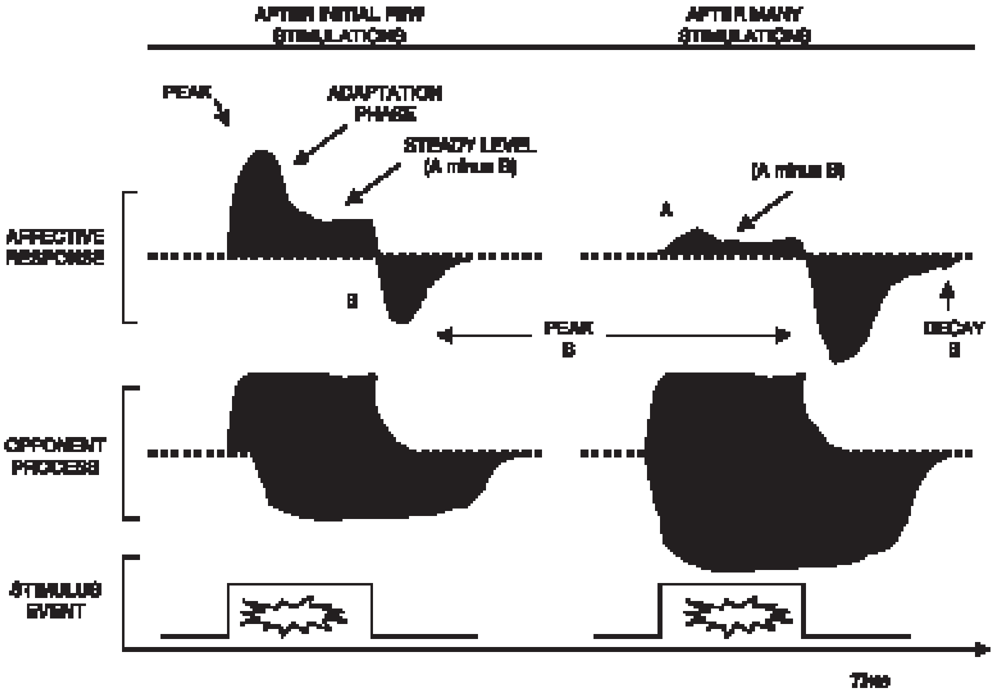

FIG. 4.1. Opponent B-processes restrain emotional responding elicited by affective stimulation. After repeated stimulation, A-process responding is significantly dampened. A similar pattern appears to occur in the case of separation anxiety, suggested by the progressively reduced magnitude of cyclic recurrence of distress during the day. See Fig. 4.2. After Solomon and Corbit (1974).

quality to the directly elicited emotion or a-processes (Figure 4.1); that is, if the eliciting a-processes are attractive, the opposing b-processes are aversive and vice versa. B-processes occur concurrently with a-processes, but the former become evident only after the eliciting stimulus is withdrawn. According to the opponent-process theory, the organism's hedonic state (general feelings of euphoria or dysphoria) at any given moment is determined by the interaction of a- and b-processes: If $(a - b) > 0$, the animal is in an A-state. On the other hand, if $(a - b) < 0$, the animal is in a B-state. Here, zero represents affective neutrality.

The latency, magnitude, and persistence of a- and b-processes gradually change as the result of repeated stimulation. Initially, a-processes are subject to robust arousal and decay rapidly after the eliciting stimulus is discontinued. On the other hand, antagonistic b-processes exhibit an initially sluggish onset and persist longer than a-processes when stimulation is withdrawn. However, after repeated stimulations (habituation), a-processes are weakened (slower latency and decreased magnitude), whereas underlying b-processes are gradually strengthened and become more persistent.

Theoretically, in terms of attachment phenomena, these differential effects of repeated a- and b-process stimulation would result in the gradual attenuation of affectional responses aroused by social contact, while at the same time progressively potentiating aversive emotions associated with the withdrawal of contact at separation. As the result of repeated separations and reunions, the psychophysiological effects associated with separation may become progressively more intrusive, while subsequent reunions may fail to satisfy fully a growing need for social comfort. Overall, the net result of these opponent dynamics is consistent with the development of an insecure or anxious

attachment and increased separation distress when a dog is left alone.

Opponent Intensification of Separation Distress

Some experimental data support the opponent-process interpretation of attachment and separation distress. For example, Hoffman and Solomon (1974) reviewed several imprinting studies showing that repeated contacts with an imprinting object intensifies separation-elicited distress. In one of these experiments, ducklings that had been repeatedly exposed to alternating periods of contact followed by withdrawal of the imprinting object exhibited mounting signs of distress whenever the imprinting object was removed. After many repetitions of this pattern, the ducklings exhibited increased signs of distress even when the imprinting stimulus was presented, suggesting that a-processes aroused by the imprinting object were being concurrently overshadowed by ascending b-processes. It is noteworthy that the successive presentation and withdrawal of the imprinting stimulus produced corresponding attractive and aversive effects sufficient to modify instrumental behavior. Ducklings learned various voluntary responses based on the contingent presentation (reward) or withdrawal (punishment) of the imprinting stimulus. Ducklings can even be trained not to follow the imprinting stimulus, if doing so results in its removal. Also, Starr (1978) reported that the most intense and frequent distress vocalizations shown by ducklings were elicited either when the imprinting stimulus was presented and withdrawn repeatedly or when it was presented for long periods before being withdrawn. In addition, he found that the interval between repeated separation trials had a marked effect on the amount of distress vocalization emitted by the ducklings. Interestingly, 1-minute intervals between trials had the most pronounced effect on subsequent separation-distress vocalization, whereas 5-minute intervals produced proportionately less distress vocalization. These findings are consistent with an adjunctive analysis of separation anxiety (see below).

Opponent Processing and Imprinting

The opponent-process theory offers a viable theoretical model for understanding some aspects of canine separation-anxiety panic. Typically, separation reactivity rapidly mounts in magnitude and reaches a peak approximately 30 minutes after the owner leaves (Voith and Borchelt, 1985; Lund and Jorgensen, 1999). This rapid onset and intensification of separation reactivity is followed by a gradual adaptation period and a steady decline of distress over a variable length of time, ranging from minutes to hours, depending on the individual dog and the severity of its separation problem (Figure 4.2). This general pattern is consistent with the sluggish latency or slow buildup of b-processes and their tendency to decay slowly after the a-process stimulus is withdrawn. This picture is in contrast to the brief latency and vigorous buildup of intense greeting activity (via a-processes) when the owner returns. Another aspect of considerable interest regarding separation anxiety and opponent-process theory is the observation that, after repeated exposures to separation, many separation-reactive dogs fail to habituate (as might be expected) but instead continue to become increasingly distressed when left alone. It follows that the planned-departure method of repeatedly leaving and returning to a dog, if not properly performed, could inadvertently intensify separation distress rather than reduce it—an outcome that is fully consistent with predictions from the opponent-process theory.

Opponent Origins of Separation Depression

Opponent-process theory also provides a way for understanding some aspects of the depressive phase of separation distress. In response to chronic separation distress, some dogs appear to withdraw emotionally, become depressed, and exhibit signs of progressive detachment toward their owners' return home. These cumulative changes may be due to B-state dominance developing over time in response to repeated separation-reunion experiences. As a result of repeated separations,

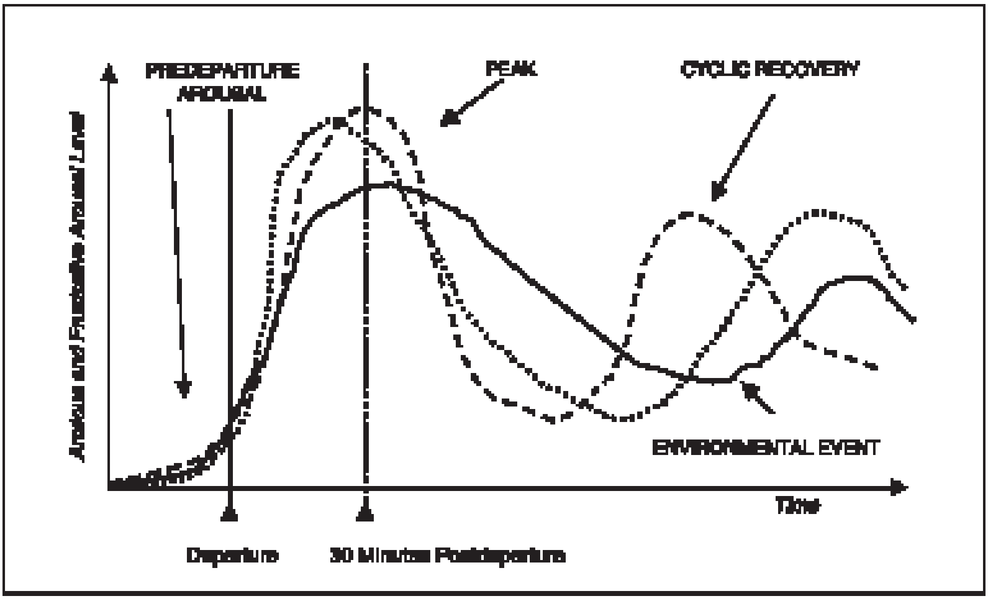

FIG. 4.2. Three hypothetical separation-reactive dogs exhibiting the general pattern of predeparture and postdeparture arousal, adaptation, and cyclic recovery. Note that anxiety and frustration levels follow a cyclic pattern of adaptation and recovery and often recovery after an environmental event (car passing by, dog barking, etc.). After Voith and Borchelt (1985) and Lund and Jorgensen (1999).

b-process feelings of loss may become sufficiently strong and persistent to overshadow a-process greeting excitement elicited by an owner's homecoming. The result is an appearance of detachment—what some owners may interpret as the dog being sullen or angry for leaving them alone. Detachment in such cases may reflect a situation in which a-process stimulation is dampened and offset by strong slave b-processes.

The duration of contact between an animal and an attachment object was a significant variable in some of the aforementioned experiments. Long periods of social contact produced more separation distress than did brief periods of contact. This finding parallels conditions often associated with episodes of separation distress in family dogs. Owners frequently report the occurrence of separation-related problems following long weekends or after holidays in which greater amounts of time are spent with their dog.

Supernormal Attachment Hypothesis

Many experiments have shown that contact with a human handler has a pronounced ameliorative effect on separation distress in puppies and dogs. The presence of a person exercises a calming effect that is often greater than occurs in the presence of other dogs. Pettijohn and colleagues (1977) found that the presence of a human handler during periods of separation had a more pronounced effect on separation distress in puppies than did the presence of its mother or a littermate. Similar effects have been observed in adult dogs. For example, Tuber and colleagues (1996) reported that dogs restrained in a novel situation with a human companion had lower cortisol levels (a sensitive measure of biological stress) than did dogs restrained in a novel situation with a canine companion. Also, Gantt and colleagues (1966) observed that petting exerted a pronounced calmative effect on

sympathetic arousal, reducing both heart and respiratory rates in separated dogs. In neurotic dogs, the effects of human presence and petting were often even more striking and robust than observed in normal dogs. Lynch (1970) reviewed the findings of various studies, confirming that aversive arousal in dogs is significantly modulated by human petting. For most separation-anxious dogs, canine companionship does not provide ersatz comfort in the absence of human contact. Voith and Borchelt (1996) report that many separation dogs are highly distressed despite the availability of another dog during periods of separation. Also, videotapes of separation-distressed dogs left alone with nondistressed dogs show that they virtually ignore the presence of their nondistressed companions. Together these findings suggest that a human companion provides a strong modulatory effect over canine separation distress, apparently more so than the relief produced by the presence of conspecifics.

One way to interpret these findings is that humans represent a *supernormal* attachment object for dogs. According to Tinbergen (1951/1969), the supernormal stimulus is an artificial stimulus or situation that is more effective in evoking some species-typical behavior than is the natural stimulus situation. In short, the supernormal stimulus produces a response of stronger magnitude than does the natural one. It is interesting to speculate that the protective influence of human contact and petting against increased distress and aversive arousal associated with unfamiliar places and fear is due to such a supernormal influence. A supernormal attachment may help to explain the peculiar psychological dependency (anaclisis) that some dogs form toward their owners (and vice versa), inclining them to develop separation-related problems. Dogs rarely present with separation-distress or panic problems resulting from the loss of canine companions: although such loss is commonly associated with a variable degree of ennui or depression, it does not frequently rise to the level of producing separation distress or panic problems. Perhaps attachment with human companions creates a supernormal feeling of well-being and safety that is lost at separation, causing heightened levels of generalized distress and panic in predisposed dogs when left alone.

Many routine rearing practices may contribute to a supernormal attachment forming between owners and dogs. Normally, nearly every activity of significance is controlled by human caretakers, making dogs virtually dependent on the presence of human help to survive. In addition to contact comfort, dogs depend on human caretakers to provide food, exercise, play, and sundry other things. What may further magnify the human as an attachment object is a growing sense of helplessness on the dog's part. Helplessness is a natural cognitive, motivational, and behavioral outcome that develops under environmental conditions in which significant events occur independently of what a dog does or does not do. Supernormal attachment as a factor in separation distress has many obvious overlapping features with the attunement and bioregulatory hypothesis already discussed. The dog may also represent a supernormal attachment object for humans. This is a particularly appealing idea, given the behavioral and morphological changes in the direction of neoteny that have occurred to the dog over the course of its domestication. The infantlike appearance and dependency of dogs may stimulate intense attachment and parenting behavior in human caretakers (Figure 4.3).

NEOTENY AND DEPENDENCY

As a result of domestication, the dog has undergone a pervasive neotenic transformation, setting the foundation for enhanced dependency. Neotenization has emphasized immature behavioral tendencies and physical characteristics in the dog. Unlike the dog's natural progenitor, the wolf, most domestic dogs cannot hunt and provide for themselves. Neoteny and enhanced docility have resulted in dogs becoming permanently dependent on humans for the provision of many of their social and physical needs. These changes have encouraged behavioral solicitousness as a means for attracting attention and care. Dependency needs appear to be stronger in some dogs, especially in those inclined to develop separation problems. Lonely puppies or neotenic dogs may feel vulnerable and in

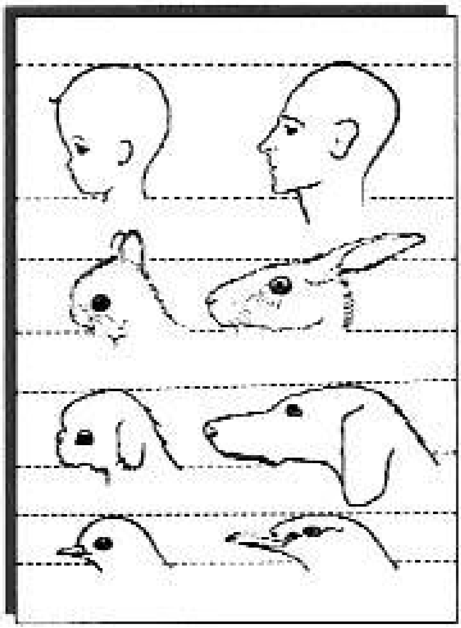

FIG. 4.3. In addition to babies, the morphology of the young of various species elicits attachment behavior, perhaps reflecting an innate releasing schema controlling attachment and parenting behavior. After Lorenz (1971).

danger when left alone—a natural reaction to separation for such dogs.

Under natural conditions, wolf pups are exposed to gradual doses of separation from group members. This exposure process is ontogenetically timed, so that a pup's increasing independence is correlated with the maturity of other physical and behavioral characteristics, ensuring readiness for greater autonomy. However, domestic dogs often grow up in an environment in which this natural learning and developmental process is impeded. They are sometimes kept in nearly constant contact with the owner and prevented from learning how to cope with the emotional demands of solitude. Instead of becoming progressively independent and secure when alone, they become overly attached, excessively dependent on the owner's presence and virtually helpless. Although physically mature, adult separation-reactive dogs may appear to be emotionally arrested at a very immature level of development, responding to separation with puppy-like signs of distress and protest.

Biological Stress and Separation Distress

Separation distress evokes neuroendocrine activity involving the hypothalamic-pituitary-adrenocortical (HPA) system (see *Stress and Separation Anxiety* in Volume 1, Chapter 3). During stressful stimulation, corticotropin-releasing factor (CRF) is secreted by the hypothalamus and carried via the portal blood supply to the anterior pituitary gland, where it stimulates the release of adrenocorticotropic hormone (ACTH). ACTH, in turn, stimulates the adrenal cortex to secrete glucocorticoids, hormones that prepare and augment the body's ability to respond to physiological stress and to defend itself against danger. Rising glucocorticoid (e.g., cortisol) levels modulate hypothalamic CRF output directly and also indirectly via the combined influences it has on the amygdala (excitatory influence over hypothalamic CRF output) and the hippocampus (inhibitory influence over hypothalamic CRF output). The antagonistic effect of cortisol on the amygdala and hippocampus regulates the amount of CRF secreted by the hypothalamus and, ultimately, the peripheral release of cortisol by the adrenal cortex. Under conditions of chronic stress, the dynamic stasis modulating stress-hormone activity may undergo regulatory breakdown, along with various other destructive physiological and immunological impairments (Selye, 1976). The hippocampus, for example, as the result of excessive exposure to cortisol, may undergo degenerative changes that impede its ability to modulate emotional reactivity and associated neuroendocrine activities.

Stress-related hormonal changes have been found to occur as the result of separation in a number of animal species. For example, elevated cortisol output rapidly occurs and peaks within two hours after young monkeys are separated from their mothers, an effect that is reversed at reunion (Marks, 1987). In the case of dogs, Tuber and colleagues have (1996) identified a differential glucocorticoid (cortisol and corticosterone) response occurring under five conditions of separation: (1) alone in a

novel environment, (2) together with a conspecific in a novel environment, (3) alone in a familiar environment, (4) together with a human in a novel environment, and (5) together with a conspecific in a familiar environment. As one might expect from the adverse additive effects of place unfamiliarity on separation distress, the researchers found that the highest levels of cortisol output occurred when the dogs were left alone in a novel situation. Conversely, the lowest levels of cortisol output occurred when the dogs were tested in their home kennel with a familiar conspecific. Interestingly, though, in light of the additive effects of an unfamiliar place on separation distress, they found that dogs tested in the novel situation in the company of a human companion exhibited significantly lower cortisol levels than measured when the dogs were restrained in a novel situation with a conspecific.

SEPARATION DISTRESS AND COACTIVE INFLUENCES

Fear and Anxiety

As already discussed, under some conditions fear of separation may significantly increase the magnitude of separation distress and lower fear thresholds. Despite the ostensive appearance of a potentiating effect of fear on separation distress, the relationship between the two emotional states is far from straightforward. A great deal of laboratory research supports the notion that separation distress per se is mediated by a relatively discrete motivational system that is functionally independent of fear but not without significant interaction with it (Panksepp, 1998). Davis and colleagues (1977) observed that among puppies separation distress was not increased by the startle of a loud noise. Although startle caused the puppies to carry their tails in a lower position, separation distress was not significantly altered by startling auditory stimulation. They concluded that "sound-induced fear and separation distress are separate and independent affective states" (203). Among chicks, separation-induced peeping is suppressed by a startling noise of a horn (120 dB) (Montevecchi et al., 1973)—the opposite effect of what one might expect to observe if fear motivationally augmented separation distress. Rather than potentiating separation-distress vocalization, fear appears to suppress separation-related distress behavior. Panksepp (1998) neatly summarizes the available data on the relationship between separation distress and fear:

> Thus, separation distress may promote activity in fear circuits, but behavioral data suggest that the converse does not occur. For instance, the presentation of fearful stimuli tends to reduce the frequency of separation calls, presumably because it would be maladaptive for young animals to reveal their locations when predators are nearby. (274)

The aforementioned separation-distress study reported by Tuber and colleagues (1996) provides data supportive of this general hypothesis. The researchers found that adult dogs exhibit different patterns of distress vocalization, depending on the familiarity of the test situation. Adult dogs, unlike puppies, tended to exhibit more distress vocalization when confined in a familiar situation than when they were confined in an unfamiliar situation. Among several adult beagles studied by Tuber's group, distress vocalizations were most strongly suppressed when the dogs were individually confined in an unfamiliar test situation. Apparently, in mature dogs the tendency to bark is more likely to occur under the *safety* of a familiar environment. When isolated in an unfamiliar environment, distress barking is inhibited, perhaps as the result of increased fear associated with novelty and unfamiliarity. Such inhibition would be adaptive under natural conditions, where, as Panksepp points out, distress vocalization might attract unwelcome attention in potentially dangerous and unfamiliar surroundings.

Panic

Again, although having some overlap and interaction at various levels of organization, separation distress and fear appear to belong to two separate neural systems in which distress-related behavior is subordinate to fear. Separation distress does not appear to depend on *anxiety* (in the sense of a foreboding or anticipatory fear of impending threat) but rather appears to operate under the influence of an

independent social motivational system—one that exercises a pervasive influence on canine social development and behavior in its own right (Scott and Bronson, 1964; Panksepp, 1988a). Separation distress and fear of separation or separation *anxiety* are not the same thing. Further, although separation anxiety may not be strongly related to fear or *threat* anxiety per se, as will be discussed momentarily, it is strongly influenced by *need* anxiety and frustration.

In some ways, separation distress appears to be even more closely related to panic than anxiety. Among humans suffering panic attacks, many report having experienced separation anxiety as children (Torgersen, 1986). During panic attacks, "the victims feel as if their center of comfort and stability has been abruptly removed, leading to active solicitation of help and social support" (Panksepp, 1998:274). Adverse traumatic or chronic activation of separation-distress circuits may gradually result in lowered thresholds for panic triggered by the loss of significant attachment objects at separation. The linkage between separation distress and panic is further supported by pharmacological studies showing that both conditions are ameliorated by the tricyclic antidepressant imipramine. Anxiolytics (e.g., benzodiazepines) have little beneficial effect on panic attacks or separation distress, although in cases where a fear of separation or a need anxiety is evident, antianxiety medications appear to provide some measure of relief.

Another way of interpreting panic at separation is in terms of behavioral helplessness. Helplessness occurs when significant events are perceived as being both unpredictable and uncontrollable. In addition to anxiety, separation distress is also probably potentiated by high levels of frustration occurring at separation. Frustrative arousal occurs when a dog's control over its attachment object is somehow impeded. Whereas the anxiety component in separation distress is primarily under the control of classical conditioning, the frustrative component is more strongly influenced by instrumental learning mechanisms. Under conditions in which the behavior of the attachment object is perceived as being both unpredictable (classical input) and uncontrollable (instrumental input), insolvable conflict may ensue at separation, resulting in behavioral helplessness (see *Conflict and Neurosis* in Volume 1, Chapter 9) and precipitous separation panic. Separation-panicked dogs often exhibit compulsive repetitive behaviors, suggesting that separation may evoke acute compulsive episodes in susceptible dogs.

Frustration

One need only consider the frustrative effects of unrequited love on attachment and proximity-seeking behavior among humans to appreciate the central role that frustration plays in the formation of social attachments. The more one becomes frustrated by some activity or goal, the harder it seems to let go, especially if the goal happens to be an intimate attachment object. Experimental evidence suggests that both frustration and discomfort may contribute to enhancing social attachment and dependency. Brodbeck (1954) performed an early experiment to compare a number of variables affecting the development of dependency in puppies, especially the relative effect of food on the development social dependency. To test his hypothesis, he built a feeding machine so that food could be delivered anonymously by a system of ropes and pulleys. Subsequently, one group of puppies was fed by machine and another group fed permissively by hand. Both groups appeared to exhibit approximately the same level of dependency during the testing phase of the experiment. He concluded that food per se did not facilitate social dependency. In a third group, puppies were fed by hand but deliberately frustrated before and while they took food from the experimenter's hand. Interestingly, he found that the frustrated, hand-fed group exhibited much stronger dependency behavior (proximity seeking) than either the permissively fed group or the machine-fed group. Similarly, Fisher (1955) found that puppies that were alternately exposed to both social indulgence and punishment exhibited a pronounced increase of dependency behavior (proximity seeking) in comparison to puppies that were indulged only with petting and play over the same period. These experiments by Brodbeck and Fisher demonstrate

that frustration and discomfort (punitive interaction) may facilitate attachment and dependency behavior. Frustration, in particular, appears to exert a prominent motivational influence on the formation of excessive dependency between humans and dogs.

The most common response to a situation where some desirable goal is obstructed is for a dog to persist or try harder. Similarly, when a dog's efforts to gain contact with its owner are unsuccessful, frustration invigorates separation-distress reactions and prompts efforts to regain contact. Many unwanted behaviors associated with separation distress, such as incessant barking and destructiveness, appear to be motivated by frustrative arousal. As frustration mounts, associated behavior patterns become correspondingly stronger and more compulsive. The contributory effects of frustration on separation distress may be quite dramatic, resulting in generalized behavioral activation involving increased activity (pacing), exploration (searching cabinets and waste bins), destructiveness (scratching, biting, and chewing personal belongings and furnishings, woodwork, doorjambs, and carpets), and barking—all emitted under a high degree of aversive arousal. In a certain sense, the perception of many owners that their dogs are acting out of *anger* may not be too far off the mark [see Berkowitz (1990)]—a common assumption that has often been criticized and rejected as a misconception (Lindell, 1997). The barking of such dogs often has a complaining and demanding quality to it—it does not affect one like the vocalization of a fearful or anxious dog. Such barking impresses one as the vocalizations of a dog that is upset about not getting what it wants, rather than a plaintive expression of loneliness, anxiety, or fear. Affected dogs may persist in their barking at separation for long periods, appearing to expect that the owner will eventually give in to their noisy demands. In fact, these dogs are frequently very successful social manipulators, having learned that persistence in the face of nonreward and punishment frequently pays off. Modifying manipulative separation behavior and replacing it with more cooperative and obedient alternatives is an important aspect of treating such problems.

Many of the problem behaviors exhibited by separation-distressed dogs are highly ritualized, repetitive, and resistant to behavior modification. Although such dogs usually tire of their efforts and gradually give up, after a variable period of remission they may be alarmed by something happening outside and the pattern starts all over again (Askew, 1996; Lund and Jorgensen, 1999). The sound of a passerby, a barking dog, or the drone of a passing car may prompt additional frustrative effort. Since internal states associated with frustration have often been present when the dog was successful in the past, frustrative arousal may provide a source of conditioned reinforcement or continuous incentive to keep trying, thereby maintaining separation-related behavior over long periods. The evident benefits of obedience training for managing or preventing separation-related problems (Borchelt and Voith, 1982; Clark and Boyer, 1993; Jagoe and Serpell, 1996; Goodloe and Borchelt, 1998) may be, in part, the result of encouraging more constructive patterns of interaction in which frustration-related excesses are discouraged and more compliant and cooperative behavior is rewarded.

In addition to persistence, regressive behavior is a common coping response to excessive frustration. Finding that some behavior no longer works, a frustrated dog may resort to other previously effective behavior patterns, including some belonging to an earlier stage of development. A common example of this sort of coping behavior in humans is the temper tantrum—a regressive response to frustration that often persists into adulthood. Distressed dogs may, under the influence of chronic frustration at separation from their owners, turn to coping strategies that proved successful in puppyhood to gain social contact. A regressive interpretation of separation-related behavior emphasizes the invigorating influence of frustration, perhaps rising to a level in which separation distress directly evokes immature species-typical contact seeking or et-epimeletic (care-seeking) behavior patterns in adult dogs. Sustained distress vocalization (e.g., whining and yelping), loss of bladder or bowel control, and increased orality among such dogs may be

interpreted along similar lines of analysis. Many separation-reactive dogs are strikingly immature, exhibiting a variety of regressive behavior patterns and needs, including excessive dependency and proximity-seeking behaviors. Frustrative perseveration and fixation, destructive (angry) acting out, and immaturity are commonly associated with dogs exhibiting separation-related problems.

Although frustration appears to be a strong motivational variable, many dogs distressed at separation also appear to be intensely worried or anxious about being left alone. Perhaps a coactive linkage between anxiety and frustration may occur in some cases of separation distress. Such motivational coactivity could produce powerful synergistic effects, perhaps leading to the more extreme and compulsive separation-panic symptoms observed in some dogs. Finally, some separation-distressed dogs may be anxious only to the extent that they fear that their efforts will not work (need anxiety), and that they will be left to endure more and more discomfort as their frustration grows and their efforts continue to fail. Panksepp (1998) has noted that the distress resulting from frustrative arousal may be more akin to *pain* than to fear, however. A dog may fear the pain of frustrative loss and, in that sense, become *anxious* about experiencing separations from its owner.

Boredom

Boredom has often been proposed as a significant cause of separation-related behavior problems (Hart and Hart, 1985; Niego et al., 1990). Turner (1997) suggests that boredom-related destructive behavior is often misdiagnosed as separation anxiety. He admonishes behavioral counselors to differentiate destructive behavior carefully due to separation anxiety from behavior caused by *boredom.* Unfortunately, he offers little edification as to what he precisely means by boredom or how it might result in stimulating destructive behavior. Although boredom is often mentioned as a possible cause of misbehavior, it is rarely described in operational terms or with the sort of precision required to assess its potential role in separation-related destructiveness or other behavior problems described as being boredom related (e.g., compulsive disorders). Finally, surprisingly few scientific papers have been devoted to the study of boredom and its effects on animal behavior, but ethologists have emphasized the role of boredom in the development of abnormal behavior in zoo (Hediger, 1955/1968) and farm animals (Fraser, 1980). Other authors have questioned the role of boredom in the etiology of such problems and have rejected the boredom interpretation as usually "simplistic and wrong" (Overall, 1997:222).

As a motivational concept, boredom can be defined as an aversive or stressful state that occurs in the absence of optimal stimulation. How animals respond to boredom depends on many considerations, including temperament (see *Experimental Neurosis* in Volume 1, Chapter 9). Some dogs, especially energetic and outgoing ones (extroverts), may respond to boring circumstances by engaging in diversionary activity aimed at achieving a more favorable level of stimulation. In essence, boredom for such dogs is an aversive state or an *establishing operation* that prompts behavior aimed at finding a means to reduce it. In other dogs, who are more withdrawn and less active (introverts), boredom may be taken more in stride or precipitate depressive forms of separation distress.

A. F. Fraser (1980) emphasizes the role of stress in the development of abnormal behavior in animals, defining stress and its relation to boredom in the following way:

> An animal is said to be in a state of stress if it is required to make abnormal or extreme adjustments in its physiology or behavior in order to cope with adverse aspects of its environment and management. . . . A feature of this definition concerns the issue of environments involving 'boredom' or physical restraint. . . . It is widely accepted that animals in monotonous and restricting environments seek out opportunities for exercise and stimulation. Most veterinary ethologists now suggest that the restriction of movement, 'boredom', thwarting of drives, stressful stimuli and deficiencies of the environment may lead to abnormal stereotyped behaviour. (237–238)

In combination, boredom and loneliness may coalesce to form a highly potent and aversive motivational state, perhaps underlying the development of certain separation-related problems. Boredom may be a source of considerable stress for dogs receiving inadequate daily stimulation and exercise. Chronic compulsive licking, causing acral lick dermatitis, may be directly related to stress resulting from separation boredom. Such compulsive habits often present comorbidly with separation-distress problems. Repetitive self-licking might offer bored and lonely dogs a self-stimulatory outlet for the stresses and tensions produced by separation. Licking may also serve a self-medicating function. Clinical evidence suggests that the activity is maintained to some extent by the release of endogenous opioids (White, 1990).

Finally, boredom may interact coactively with frustration, especially in cases where boredom-related exploratory behavior or other efforts to escape the situation are thwarted. Finally, although boredom may be a contributing factor in the etiology of some separation problems, it is unlikely that boredom alone is a significant motivational factor in the precipitation of the classical symptoms of separation distress. Boredom takes time to build up and, consequently, one would expect it to exert its most pronounced effects on behavior after some significant period had elapsed following separation. Typically, however, separation-related arousal and distress usually begin before the owner departs and continues building up for many minutes thereafter before gradually leveling off and dissipating (Voith and Borchelt, 1985).

Compulsion

As already noted, a fear probably plays a relatively secondary role in the development of anxiety at separation. In addition to a premonitory apprehension about some potential threat at separation, another possible source of anxious arousal is anticipated loss or *need anxiety,* which is common among both dogs and humans in response to the anticipated loss of an attachment or appetitive object. In the case of an attachment object, need anxiety expresses itself as obsessive worry and vigilance about the whereabouts of a lost object of affection or comfort. The sense of loss and worry about the owner's whereabouts may trigger exaggerated exploratory activity and other behavior under the control of the seeking system [see Panksepp (1998)]. Under conditions of high conflict and stress, especially in cases where such efforts are intermittently successful to reduce distress (e.g., owner returns or dog obtains internal relief from the worry), adjunctive or displacement behaviors may emerge in a variety of forms (see *Adjunctive Behavior and Compulsions* in Chapter 5). Many of the behavior patterns exhibited by separation-reactive dogs at separation do, in fact, appear to take on a compulsive character. In the laboratory, under certain schedules of reinforcement, various adjunctive behavioral excesses are generated, including excessive drinking, wheel running, object shredding, self-licking, and even aggression—if an adequate target is available. Under such conditions, Panksepp (1998) notes, "Animals appear to vent the frustration of neuroemotional energy emerging from unfulfilled expectations on any available target" (161). Whereas threat anxiety refers to an apprehension resulting from an inadequately predicted threat, need anxiety results when a highly attractive stimulus is lost and its future return is inadequately predicted.

Separation-reactive dogs may be conflicted between a desire to remain in close social contact with their owners while being prevented from doing so by an intervening barrier. This barrier can be either physical or emotional, that is, the owners may be emotionally withdrawn or rejecting toward their dogs. The conflict involves two antagonistic pressures demanding two mutually exclusive and opposing responses. On the one hand, a dog is highly motivated to maintain intimate social contact with its owner, whereas, on the other, it is physically or psychologically prohibited from doing so. When left alone at separation, most dogs simply accept their state of affairs and slip into a stoic state, patiently waiting for their owner to return. Separation-reactive dogs, however, are unable to control or cope with their volatile feelings of loss and worry. The experience of separation loss triggers growing levels of anxious

and frustrative arousal, causing them to worry over their owner's whereabouts and compelling them to act in compulsive ways to restore contact. The most common compulsive responses to separation anxiety are rituals involving distress vocalization, pacing, and checking for their owner's reappearance. In some dogs, such behavior can continue on for hours with only brief interruptions.

Fun

Some authors, most notably Ian Dunbar (1998), have popularized the rather misleading and problematic belief that destructiveness in the owner's absence is most often an expression of *separation fun* rather than separation distress or anxiety. According to Dunbar's thesis, predeparture arousal in such dogs is not necessarily the result of excessive stress or worry; on the contrary, such behavior is most often a sign of percolating excitement over the prospects of engaging in destructive play activities without interference or risk of punishment from the owner. Dunbar reasons that dogs simply cannot wait for their owners to leave the house so that they can go about their destructive rounds in safety. His solution to such behavior problems is to set up beer can booby traps and to provide such dogs with attractive rubber toys, thereby redirecting their destructive "fun" into more acceptable outlets.

Dunbar's thesis does not enjoy very much empirical support. Although a very small percentage of dogs may look forward to being left alone so that they can play in peace, personally I cannot recall any dogs exhibiting such pleasure about being isolated or any reports indicating that some dogs look forward to being left alone so that they can play by themselves. The phenomena may occur but must certainly be very rare. Undoubtedly, many dogs do engage in exploratory and playful activities that may result in the destruction of household items, and some of this behavior may increase during an owner's absence when it is not prevented (Voith and Borchelt, 1985); on the whole, however, when destructive behavior is motivated by play and exploration, it usually occurs regardless of the owner's presence or absence (McCrave, 1991; Lindell, 1997). In fact, many destructive dogs exhibit little or no concern about their owner's displeasure at their destructive adventures and may even taunt the owner with a forbidden object in order to elicit a chase-and-catch routine. Nothing could be more *fun* for such dogs. However, with respect to the vast majority of separation-reactive dogs, separation is far from fun; on the contrary, it represents a significant source of psychological distress for them.

One can safely venture to assume that the vast majority of dogs that exhibit destructive behavior only at times when they are left alone probably do so as the result of separation distress. Providing such dogs with rubber toys stuffed with food, as recommended by Dunbar, will not hurt but will probably not provide much relief either, since appetite is typically suppressed in such dogs. Unfortunately, many owners, convinced that their separation-distressed dogs are simply having a good time at their expense, may not be so understanding, generous, or patient with their dog's "playful" excesses. Led to believe that their dogs are just having fun, and finding that they ignore the toys that they are given but instead continue to chew on pillows and woodwork, frustrated owners may elect out of desperation to take more drastic measures. Although Dunbar is careful to note the dangers of retroactive punishment, such owners, upon recognizing that the recommended method does not work, may resort to severe punishment at homecoming in an effort to take some of the fun out of their dog's destructive game.

PART 2: ONTOGENESIS OF SEPARATION DISTRESS

Development of Attachments and Separation-related Distress

Many studies of separation distress indicate that both social and place attachments influence the level of distress expressed by isolated animals. Place attachments appear to precede and prepare developing puppies for the elaboration of social attachments. For example, a puppy's initial attachment to its mother is

probably motivated more by place and physiological interests such as thermoregulation and nutrition than by social needs. In line with this idea, Scott (1980) proposes that the evolution of mammalian social attachment probably grew out of more primitive place attachment tendencies. Beginning at approximately 3 weeks of age (Scott and Fuller, 1965), with the emergence of maturing sensory, motor, and cognitive abilities, puppies turn progressively toward more organized and purposive social interaction with conspecifics. At about this time, a puppy begins to exhibit intense signs of distress when separated from its mother and littermates.

Social Comfort Seeking and Distress

The ontogenetic transition from primitive place attachments to social attachments may be mediated by the sense of smell. According to Rosenblatt (1983), early approach-withdrawal (A-W) reactions mediating vegetative functions like thermoregulation, feeding activities, and reflex elimination are ontogenetically elaborated into more mature seeking and avoidance patterns through the modality of smell. According to this theory, olfactory sensations that occur in association with tactile and thermal A-W reactions are classically conditioned, thereby becoming the basic positive and negative stimulus incentives governing seeking and avoidance behavior. Presumably, olfactory incentives also mediate lasting maternal attachments and social bonding between littermates. Evidence for the importance of olfaction in the development of social attachment and, probably, the evocation of separation distress comes from several kinship recognition studies (Hepper, 1986, 1994; Meckos-Rosenbaum et al., 1994). Additionally, it should be noted in this regard that separation-anxious dogs frequently seek out and "worry" personal belongings (e.g., socks, undergarments, and pillows) bearing a strong odor of their absent owner.

The owner's odor in such cases may elicit conditioned regulatory responses serving to maintain psychobiological attunement in the absence of the actual attachment object—learning that may be mediated by opioid activity (D'Amato and Pavone, 1993) and other neuropeptide systems (oxytocin and arginine vasopressin) involved in the formation of social memories (Panksepp, 1998). According to this hypothesis, an owner's scent may elicit conditioned opioid activity, thereby physiologically reducing separation-related distress and comfort-seeking behavior (see *Limbic Opioid Circuitry and the Mediation of Social Comfort and Distress* in Volume 1, Chapter 3). Low doses of morphine appear to reduce tail wagging and contact-seeking behavior in adolescent dogs, whereas the opioid antagonist naloxone increases such social behavior (Knowles et al., 1987). Interestingly, separation-reactive dogs often show signs of pruritus (itchiness), intermittently scratching themselves while excitedly greeting their owner. Halliwell (1992) suggests that this pruritic activity may be due to endorphin-released histamine activity:

> Opiates are well-known histamine-releasing agents, and so it was not surprising when it was shown that endorphins could also cause histamine release, both *in vitro* and *in vivo.* Histamine release is blocked by the opiate antagonist naloxone. It is possible that when dogs become pruritic while exhibiting signs of euphoria (e.g., upon the return of the owner), they may in fact be experiencing pruritus from histamine release rather than merely exhibiting a behavior quirk. (897)

This observation is consistent with the important role opioids play in the development of social attachment and distress. Perhaps, during excited greetings, dogs receive a high opioid dose followed by a sustained "drip" while in continuous contact with their owner, thereby facilitating a physiological *addiction* to attachment that results in withdrawal distress during periods of separation. In fact, dogs with separation distress present many of the same symptoms exhibited by human addicts suffering withdrawal from narcotics (Mauer and Vogel, 1967):

> When an addict misses his first shot, he senses mild withdrawal distress ("feels his habit coming on"), but this is probably more psychological than physiological, for fear plays a considerable role in the withdrawal syndrome. . . [after a passage of time] the addict becomes progressively nervous, restless and anxious, and close confinement tends to intensify these symptoms. . . he will begin to yawn fre-

> quently. . . . [with more time] all the body fluids are released copiously; vomiting and diarrhea are acute; there is little appetite for food, and the addict is unable to sleep. (95–96)

A growing body of behavioral and neurobiological research has demonstrated that endogenous opioid activity plays a central role in the formation of social attachment (Panksepp, 1998) and imprinting (Hoffman, 1996). Among mammals, social attachment is also strongly influenced by the modulatory influences of oxytocin, prolactin, and arginine vasopressin. Oxytocin is a posterior pituitary hormone that is released by way of touch stimulation of the nipples, causing the contraction of smooth muscles in the mammary glands to pump milk. Oxytocin not only mediates maternal behavior but also appears to facilitate attraction of the young toward their mother. Panksepp notes that oxytocin exercises some significant agonist effects over opioid systems, sensitizing them to opiate substances and making them less responsive to the effects of opioid tolerance. Consequently, oxytocin may render a mother particularly responsive to attachment signals and help to sustain long-term nurturing bonds with her young. Like opiates, oxytocin and prolactin (a pituitary hormone that stimulates milk production) exert powerful inhibitory effects over separation distress. Finally, oxytocin (and arginine vasopressin) appears to facilitate the formation of lasting social memories, thereby complementing underlying neurophysiological attachment processes mediated by the neuropeptide.

Social Attachment versus Place Familiarity

Fredericson (1952) was first to perform controlled experiments to isolate the relative contribution of social attachment versus place familiarity in the expression of separation distress. He found that the most explosive separation reactions occur when a puppy is socially isolated in an unfamiliar place. According to his analysis, the goal of separation-distress vocalization is to restore a hypothesized state of perceptual homeostasis that is disrupted by the loss of social contact within a familiar home setting. He proposes the following hypothesis concerning the relationship between social and environmental factors and the elicitation of separation distress:

> A decrease in predictable social relationships and the absence of known environmental stimuli both elicit behavior patterns which are aimed at the immediate resumption of perceptual homeostasis. (477)

Ross and colleagues (1960) confirmed Fredericson's general observations. In their experiment, puppies ranging from 3 to 6 weeks of age were confined to a small triangular box located within the home pen. The authors observed that puppies exhibited the most frequent and strong distress vocalizations when they were restrained alone. When confined with a littermate, distress vocalization was significantly attenuated. In addition, they discovered an important fact that anticipated current therapies for managing separation-distress panic: puppies gradually learn to adapt to separation-distress-eliciting situations:

> Over the period of 10 trials, the mean number of yelps for both the restrained alone and non-restrained-together groups showed a significant though gradual decrease. It is more likely that this decrease is due to adaptation to the situation and learning rather than to maturation. . . . The most likely explanation is that the puppy learns that it will be released after a short time, and hence becomes less disturbed emotionally. (4)

In addition to learning, ontogenetic changes also play an important role in the reduction of separation distress in developing puppies. Elliot and Scott (1961) found that separation-distress reactivity first appears with the onset of the socialization period at 3 weeks of age, peaks between weeks 6 and 7, and then rapidly declines over the next several weeks. Scott (1988) notes that distress reactions are extremely persistent in 3- to 4-week-old puppies:

> Descriptively, puppies first show a response to separation from either a familiar site or from other animals when they are between three and four weeks of age by emitting continuous vocalizations at the rate of 100 or so per minute. These continue indefinitely unless alleviated, with occasional slowing down because of fatigue. During separation, puppies will not eat

> and sleep very little if at all. I have never tried to isolate puppies of this age for longer than twenty hours a day over five days. In this case, the puppies became so debilitated that I feared that they would die if the separation were continued. (33)

Separation-distress vocalizations by 6-week-old puppies are most frequent and intense during isolation in a strange situation (1400 vocalizations in 10 minutes) versus a familiar place (400 vocalizations in 10 minutes). Between weeks 12 and 16 (coinciding with the close of the socialization period), the amount of distress vocalization emitted continues to decline, providing evidence of increasing behavioral adaptation to the emotional distress aroused by isolation or, perhaps, reflecting the development of an underlying maturational process.

Cairns (1975) has also studied the effects of social isolation on puppies but has arrived at substantially different conclusions regarding the effects of isolation on behavior. He confirms that most isolated puppies exhibit pronounced signs of distress for several hours following separation from littermates but emphasizes that, by the end of 8 hours of isolation, they had recovered their composure and resumed normal activities like eating, chewing, grooming, and sleeping:

> Displacing the intense, high-arousal behaviors are actions of a normal, species-typical form. By the end of the second day, the shift to normative levels of eating and sleeping was virtually complete: the puppies had seemingly adapted to the companionless environment. . . . Recurrent introduction, and removal, at different intervals following the first separation indicated that the young had become accustomed to the absence of their companions. (7)

In conflict with earlier findings of Scott and coworkers (1973), Cairns found that long-term separation had little effect on appearance, weight, activity, or vigor; neither was there an observable increase in the susceptibility to disease. Many of Cairn's findings are at odds with previous assumptions and observations concerning the pathological effects of separation distress. He writes,

> Attention to the dramatic initial responses of the young to isolation—the first 10 minutes—has preempted consideration of the more mundane settling down adaptation to the new living conditions. The course of dynamic changes in behavior seems not unlike that described by Canon (1929) in his account of the physiological responses to emergency situations. In brief, the change in social context serves to produce a state of heightened preparedness for action, with accompanying sympathetic arousal. The young become primed, in effect, to perform vigorous responses—flight or freezing, escape or crying, retreating or clinging—as these are determined by the circumstances and species-typical propensities. When these vigorous actions are ineffective or unnecessary, the arousal gives way to cyclic homeostatic process and the emergence of tonic levels of activity, including maintenance responses of eating and sleeping. Adaptation—both physiological and social—to the new circumstances occurs within a reasonably short period. (1975:9)

More recently, a study involving puppies separated from their mother at 6 and 12 weeks of age seem to side with Scott's findings regarding the deleterious effects of early and prolonged separation distress. The study found that 6-week-old puppies exhibited significant adverse effects as a result of early separation from their mother in terms of general health and weight gain, impairments that were not observed in older puppies kept with their mother until they were 12 weeks old (Slabbert and Rasa, 1993). Further, the authors noted that the untoward effects of separation from the mother at an early age were directly related to behavioral indicators of increased separation distress. The study appears to confirm Scott's findings that separation distress has serious psychosomatic implications for developing puppies. (Also, see *Social Attachment and Separation* in Volume 1, Chapter 2, for an additional discussion of the effects of attachment and separation on puppy behavior and development.)

The canine socialization process begins around week 3 after birth and continues through week 12 or so (Scott and Fuller, 1965). Throughout this period, as permitted by opportunity and circumstances, attachments are readily and concurrently formed with both conspecifics and humans. As already discussed, a very influential attachment object

for a puppy during this time is its mother. Adoption is a process in which the human adult assumes the role of surrogate mother, and other family members (especially children) become substitute littermates. A significant outcome of secondary socialization is the perpetuation of a puppy's dependency into adolescent stages of development and, in many cases, persisting throughout its life. However, for puppies to develop a confident adult attitude with sufficient security and emotional stability to enable them to cope when they must be left alone, owners should follow the lead of canine mothers by gradually weaning the puppies, so that they acquire a healthy sense of self-security and independence.

Attachment and Learning

The study of social affiliation has revealed that attachments are strengthened by a simple learning process, whereby "the puppy is punished for separation and rewarded for reunion" (Scott et al., 1973:10). Separation from significant sources of attachment elicits aversive arousal that prompts frantic efforts to restore contact with attachment objects. The restoration of contact evokes relief, enhanced well-being, and increased levels of attachment toward the group and place where reunion occurs. Proximity and contact-seeking behavior that results in reunion are negatively reinforced. In combination, separation distress followed by the comfort and relief associated with reunion reduces the likelihood that a puppy will lose contact with conspecifics or wander too far away from the nest site in the future—at least until it is developmentally ready to do so.

As a puppy develops and begins to explore the wider environment, the mother and nesting site provide a base of security for such excursions. If frightened during these exploratory jaunts, the puppy will quickly retreat to the safety of the mother and nest. An extreme form of this tendency can be observed in some dogs exhibiting intense fears or phobias. When scared, such dogs may frantically seek physical contact with their owners and press up against them (positive thigmotaxis) in an apparent effort to alleviate fear. Not only does such contact reduce fear, it may also deepen the dog's attachment and dependency on the owner. As a result, fearful dogs may be more prone to develop separation-related problems involving anxiety and panic. Although not all dogs exhibiting separation problems are fearful, many do appear to have collateral fear-related problems.

The motivations underlying social and place attachments are epigenetically elaborated into various allelomimetic behavior patterns (packing) and territorial imperatives. Social attraction and affiliation fortify group cohesion and unity, thereby providing a foundation for complex social activity and cooperation:

> One of the most important motivational systems in dogs is allelomimetic behavior, seen also in schools of fish, flocks of birds, and herds of mammals. It is defined as doing what the other animals in the group do, with some degree of mutual imitation, and often results in a high degree of coordination. It is a major system of behavior in dogs, and *if one wishes to understand their psychology, the most important thing to remember is that dogs love company and suffer without it* [italics added]. Such company may be either canine or human, and in order to maintain it they must do what their companions are doing, i.e., express allelomimetic behavior. (Scott, 1980:136)

Dogs strive to maximize social contact and abhor separation from the group. This is a basic motivational principle of dog training and behavior modification. A dog's "desire to please" is really a desire to stay close and to avoid rejection.

In summary, the socialization process is driven (at least in part) by a dynamic interplay between an innate aversion toward separation and the relief experienced when contact with a familiar group and place is restored. These primitive separation dynamics are epigenetically elaborated into more complex social exchanges involving organized group activity that takes place within a familiar territorial space. The avoidance of separation, therefore, plays a prominent role in the development of a coherent and stable family-pack unit and the maintenance of a territory. This effect is significantly amplified when separation is associated with fear, as in the case of dogs having phobias.

Early Trauma and the Development of Behavior Problems

The etiology of adult canine separation distress is not fully understood. A commonly entertained, but unproven, account suggests that separation-elicited distress in adult dogs may be the result of early traumatic experiences or inadequate socialization. A significant body of literature indicates that a puppy's brain develops in response to sensory, cognitive, and emotional stimulation. During early sensitive periods when the brain is undergoing significant differentiation, stressor-activated neurotransmitters and hormones may permanently affect the organization of the puppy's brain (Fox, 1971) (see *Stress and Separation Anxiety* in Volume 1, Chapter 3). The available information on the relation between early trauma and adult separation distress is ambiguous and inconclusive, but some data do suggest that a significant linkage exists between certain early experiences and adult separation-related behavior problems. Serpell and Jagoe (1995) found that puppies that had suffered serious pediatric illnesses were more likely to exhibit separation-related barking problems as adult dogs. The authors speculate that increased attention and care shown toward the sick puppies may have predisposed them to develop separation problems later on in life. But, not only is excessive attention a potential source of problems, so is a lack of attention. Puppies left alone for 6 to 8 hours during the day exhibited an increased risk for developing separation-related destructiveness or excessive barking problems at maturity. Borchelt (1983) suggests that removing a puppy too early from its mother may predispose it to form excessively strong attachments with its owner. Similarly, he suggests that a failure to form satisfactory attachments until after 4 or 5 months of age may also result in overattachment and predispose the dog to separation-related problems.

Many young dogs appear to be highly resilient to the effects of traumatic punishment, as demonstrated by a series of controversial experiments performed by Fisher (1955). Fisher's study began with puppies at 3 weeks of age and continued until week 15. One group, referred to as punished-indulged (P-I), was exposed to a daily round of intensive social contact involving affectionate petting and holding, followed by a half-hour of noncontingent punishment, consisting of very rough handling, switching, and shock. Puppies could escape punishment by fleeing from the experimenter and hiding behind a panel, but they were often chased there and punished more, essentially making the punishment inescapable. Also, these P-I puppies were individually exposed to severe social inhibitory training. At weeks 5, 6, 7, 9, 11, and 13, each P-I puppy was coaxed to come to the experimenter located at the far end of a runway, whereupon it received a strong shock.

Of relevance to separation-related problems, Fisher found that P-I puppies exhibited significantly higher dependency measures (proximity-seeking behavior toward the passive experimenter) than exhibited by another group of puppies (indulged) that had received only indulging and playful interaction during the same period. By week 12, P-I puppies spent nearly threefold as much time in close proximity with the experimenter than did indulged puppies. These findings suggest that puppies exposed to severe punishment in combination with rewards and social attention may form excessively dependent bonds with their owners. What is perhaps most surprising about Fisher's study was the finding that *all* P-I puppies rapidly recovered from overt signs of fear and timidity, with *no significant or lasting adverse side effects.* An even more striking observation was made involving a group of puppies that had been socially isolated throughout the 12-week period of the study (*punished-isolated*), except for a daily half-hour period of punishment that they received from the experimenter. According to Fisher, *nearly all* of the punished-isolated puppies also exhibited rapid recovery at the conclusion of the treatment phase of the study. Finally, puppies that had been isolated throughout the treatment phase, without any exposure to human contact, showed very pronounced and permanent social deficits in response to contact with humans and other dogs. Fisher summarizes his findings and conclusions:

> The rapid recovery of all Punished-Indulged puppies and nearly all Punished-Isolated puppies was striking. Such rapid remission of symptoms provides evidence against the hypothesis that early trauma has extreme and persisting effects on later behavior. Since all early social and exploratory opportunity led to punishment for the Punished-Isolated group, the data would also seem to limit the application of the "critical period" hypothesis. Scott termed the third to tenth week of age as critical for development of social adjustment in the puppy and hypothesized that traumatic experiences occurring during this period should have the greatest effect on later behavior. Trauma and stress applied to the Punished groups during this entire period did not lead to an inability to make an adequate later social adjustment with both humans and other puppies. . . . The present study would suggest that very early trauma may not be chiefly responsible for abnormal social behavior in dogs. (79–80)

Etiology: Traumatic Loss and Other Adverse Separation Experiences

Dogs exposed to excessive or traumatic separation experiences early in life may fail to mature normally and instead develop regressive, puppylike reactions to being left alone. Normally, distress at separation attenuates as a puppy grows older, but in the case of separation-reactive dogs this normal pattern of progressive tolerance for the loss of social contact does not occur. Panksepp (1988b) speculates that many human psychiatric conditions may be traced to adverse exposure to separation distress in childhood. In particular, he notes that there is a positive correlation between frequent and intense childhood separation experiences and the development of panic disorders: "This suggests that intense early activation of separation-distress circuitry may sensitize the system for heightened activity of the system during adulthood" (61). The separation-distress substrate may be sensitized by the enhancement of perceptual mechanisms accessing the system or by trauma-induced "biochemical and neuronal proliferation of the circuit" itself (see *Limbic Opioid Circuitry and the Mediation of Social Comfort and Distress* in Volume 1, Chapter 3).

Adverse Rearing Practices That May Predispose Dogs to Develop Separation-related Problems

Normal puppies are prone to experience varying degrees of separation-related distress when left alone. Such distress is expressed in worried activities aimed at regaining contact with the absent attachment object. Under natural circumstances, separation-distress behavior is adaptive in the sense that it helps puppies to maintain contact with their mother and the nurturance, warmth, and protection that she provides. Naturally, such behavior has strong survival value for the biologically dependent and vulnerable puppies. In the domestic environment, however, separation-related behavior may become difficult to manage and possibly develop into more serious behavior problems in adult dogs.

As already noted, separation distress may suppress interest in food and water (psychogenic anorexia), and chronic distress may prevent puppies from thriving and growing properly. Like dominance aggression, separation anxiety is not easily resolved once it has established itself, and it behooves conscientious dog owners to take measures to prevent it from developing in the first place. Prevention is the key to managing separation distress (Voith, 1981). Consequently, training puppies to cope and respond appropriately to their owner's absence should be an integral part of early socialization activities.

Care should be taken to safeguard against traumatic handling or excessive isolation, especially during the first few days after the puppy enters the home. A sensitive and separation-reactive puppy may be strongly affected by these first impressions—experiences that may exert a pronounced and lasting influence on its subsequent social development. Unfavorable experiences, such as traumatic isolation or inappropriate punishment, are particularly problematic since they may elicit intense emotional arousal and distress at a particularly sensitive time. As already pointed, both punishment and isolation may increase social attachment levels and sow the seeds of unforeseen attachment and separation problems appearing later in life. Repeated noncontingent

punishment and long bouts of isolation may be particularly problematic in this regard.

As the result of ill-advised rearing practices and abusive handling, a puppy's adaptation to domestic life may be disrupted and disorganized. Instead of finding conducive outlets for the orderly expression and satisfaction of its developmental needs, a puppy may be faced with overwhelmingly restrictive and desultory punitive demands aimed at suppressing its behavior rather than actualizing it. Meanwhile, the genetically timed opportunities for optimal adjustment inexorably pass by, leaving a permanent schism between the dog's biological potential and its actualization. In short, the domestic environment may consciously or unconsciously constrain, disrupt, or disorganize critical maturational processes during sensitive and influential periods of development. These early influences may exert lasting adverse effects on a dog's behavior and ability to adjust, possibly playing a functional role in the etiology of separation anxiety and other serious behavior problems.

As previously noted, a possible predisposing influence on separation distress is fear. Under the prompting of fearful arousal, a dog may seek the security of close proximity to its owner. If fearful arousal is reduced as the result of such contact, escape/avoidance behavior is negatively reinforced and attachment levels with the owner may be increased. Over time and repeated exposure to the fear-eliciting situation, the dog may develop an inordinate emotional dependency on its owner, expressing itself in a pronounced fear and unwillingness to be left alone. This effect may be even more pronounced in dogs affected by a negative cognitive set (learned helplessness), causing them to view the home situation as something outside of their control. From the perspective of the helpless dog, others may be perceived as the only reliable source of control and security. Consequently, such dogs may be more prone to form excessively dependent bonds with family members perceived to be in control of the situation. By attaching to such individuals, the dog may obtain a sense of heightened control and security by proxy. Along with other factors, such considerations may affect the differentiation of attachment levels between the dog and various family members.

Although crate confinement can be useful for certain training purposes, it can also be easily abused by dog owners and become the source of considerable distress for dogs (Campbell, 1991). Excessive crate confinement represents a significant welfare and quality-of-life concern. Thousands of family dogs spend 10 to 18 hours or more every day confined to wire or plastic cages. Paradoxically, the daily tedium and loneliness of crate confinement may cause dogs to gradually acquire a dependency on such restraint, an outcome that their owners may wrongly interpret as a sign of positive adjustment to crate confinement. Such dogs may become bizarrely aroused with evident distress (pacing and panting) when they are let of their crates alone or when access to them is prevented. Consequently, when dogs that had been previously confined to a crate are permitted to move about the house, instead of relaxing and quietly enjoying their new liberty, they may instead become highly active and exploratory, perhaps becoming destructive or eliminate, even though they do not soil the crate. Likewise, after months of crate confinement at night in a kitchen or, worse yet, in a basement, access to the bedroom to sleep may result in restlessness and an inability to sleep. Some of these dogs may even rub against walls and furniture, seeming to seek the contact comfort of crate walls. These signs of distress and disorientation continue until the dog is put back into its crate, thereby confirming the owner's belief that the dog likes its crate. These effects may be related to what Fuller (1967) has described as "emergence-stress," a cognitive and perceptual overload resulting from the experience of novel and complex situations. Finally, although crate confinement may prevent some destructive behavior and elimination problems, its benefits may be offset by many untoward side effects associated with excessive isolation of the dog from family members and the home environment. Patronek and colleagues (1996) have reported that crate confinement represents a significant

risk factor for relinquishment of the dog to an animal shelter, raising the possibility that excessive crate confinement may exercise an adverse influence on attachment levels and the performance of appropriate training activities. Instead of training the dog or treating a behavior problem, the owner may rely on the crate as a way to control the dog's behavior.

In summary, two significant and problematic influences converge on developing puppies that may incubate into serious separation-related problems appearing later in adulthood:

Learned helplessness: Having formed strong attachment bonds with its littermates, the mother, the breeder, and, perhaps, a family of children and other human caretakers, susceptible puppies may experience a traumatic loss of control (helplessness) as the result of being abruptly removed from one social situation and then abruptly thrust into an entirely different one. The sense of helplessness is further increased by excessive crate confinement, noncontingent punishment, and a general perception that significant events (both attractive and aversive) occur independently of what the puppy does.

Fear of separation: Social and place attachments are a dog's basis for security and contentment. During separation, thresholds for fear may be lowered, resulting in increased anxious arousal. With the loss of security that the owner represents, a dog's growing fear of *fear* may coalesce with mounting separation distress and result in heightened separation distress and panic. One would expect in cases where a history of traumatic attachment loss and helplessness exists that the separation-fear response would even be more dramatic because the dog believes that it cannot control it without the owner's help and comfort. Finally, where phobias (e.g., fear of thunder) exist, a dog may tend to form an abnormally strong dependency on its owner as a base of security and means for modulating fear and panic. In cases where a high degree of helplessness and phobia exist in the same dog, one would predict a high probability of severe separation-anxiety panic.

Comparison Between Dog and Wolf Exposure to Social Separation

Under natural conditions, wolf pups are left alone for extended periods as early as 3 to 4 weeks of age. At about this time, wolf pups first emerge from their den but will quickly flee back into its protection at any sign of danger. As a pup matures, it gradually moves away from the den and begins to explore the surroundings, often in the company of littermates or the protective supervision of a juvenile "sitter." Eventually the use of the den is abandoned altogether at approximately 10 to 12 weeks of age (Young and Goldman, 1944/1964; Zimen, 1981), requiring that the pup participate more actively in pack life. This period of development is associated with the further elaboration and refinement of emergent allelomimetic tendencies. Food is no longer brought to the pups, but now they are required to follow adults to distant kill sites that become "loafing spots" for a few days of eating and playing until a fresh kill is made somewhere else. This ontogenetic pattern is probably genetically timed, biologically preparing each behavioral step with the maturation of a physical and psychological substrate sufficient to support it. The transitions from the den to the wider surroundings (ultimately leading to the notion of territory) and from close attachments for the mother and littermates to other group members (ultimately leading to full integration within the pack) are gradually accomplished. It is a process of social and territorial integration, extending the primitive attachment impulse from the mother, littermates, and den to other attachment objects and places, thereby facilitating a more perfect adaptation of the wolf to its social group and environment in preparation for adult life.

Dog puppies are exposed to a very different pattern of socialization and environmental exposure than that just described. The usual clip of events is more composed of abrupt jumps and bumps rather than smooth integrative transitions. Essentially, puppies are taken from familiar and secure circumstances and thrust into an unfamiliar and insecure

environment. This transition from the breeder to the home is often carried out without much being done to minimize the potential trauma resulting from the experience. For example, many puppies spend the first night isolated in a crate in a remote part of the house, where they may yelp and whine themselves to sleep. Some owners may even see fit to punish a noisy puppy severely before realizing that such treatment simply makes matters worse. These aversive events marking the puppy's introduction into the home may be conducive for the development of learned helplessness. [For an excellent review of the potential role of learned helplessness in the etiology of separation anxiety, see Mineka and Suomi (1978)]. Helplessness and dependency are inevitable outcomes in situations where excessive punishment and confinement are the primary means used to control puppy behavior.

Under the ideal conditions of a wolf pack, a gradual transition away from the mother and denning site takes place over several weeks, allowing wolf pups to form alternative relationships and place attachments with a minimum of disruptive stress. These lupine ontogenetic transitions are, metaphorically speaking, orchestrated in the form of an outward expanding spiral that gradually encompasses the total social and physical environment, thereby perfecting a wolf pup's behavioral adaptation. A wolf pup's individuation occurs under the influence of a highly conducive social milieu operating under an open sky, producing minimal amounts of emotional distress while maximizing opportunities to enhance its adaptation. In contrast, domestic dogs may be exposed to the most unfavorable and disorderly conditions that maximize emotional distress and severely limit adaptive opportunities. Finally, wolf pups gradually become independent with a strong sense of control over what occurs or does not occur to them. Puppies, on the other hand, become progressively dependent on their owners for everything. Their food, exercise, affection, and most other significant needs may occur independently of what they do or do not do, rendering them all the more helpless and dependent.

PART 3: SEPARATION-RELATED PROBLEMS

Long ago, Fowler Bucke (1903) collected a number of intriguing reports written by children about their family dog. Of particular interest was the way the children described separation distress. The sensitivity, simplicity, and objectivity of these childhood anecdotes give them lasting value:

> When I am away she will hunt for me every where, and whine if they show her any of my clothes.
>
> When all went out he would bark and cry.
>
> It never wanted to be left alone.
>
> When we left it alone it would go around the house crying looking out of the windows.
>
> Poor little thing was so homesick that he did not touch food for a day.
>
> He died because mamma, for whom he had so much love, was taken to the hospital for an operation.
>
> When my mother died he felt so homesick that he got sick and would not eat. We had to take him to the hospital. (1903:505)

These reports underscore the dog's perennial tendency to form strong bonds with people and to suffer when the attachment object is lost. Although the dog's devotion and faithfulness have been often praised throughout its long history with us (see *Dog Devotion: Legends* in Volume 1, Chapter 10), its distress at separation is not always welcome or the subject of celebration, especially when it is the cause of behavior problems. A fascinating psychiatric case study reported by the psychoanalyst Marcel Heiman (1956) contains a revealing reference to separation anxiety and the despair it sometimes causes for dog owners. A female patient under Heiman's care expressed dire concerns and worry about her dog's elimination problem—a problem that occurred only when she was away from home:

> I am concerned about Robin's "crapping" and "peeing". Maybe it is due to my leaving him and not giving him enough attention. Maybe

> he feels we will never come back. I wonder about myself, coming home from school with nobody home. I was terrified that my mother and father would never come home. I would cry and cry. . . .

Later, she confided to Dr. Heiman,

> My neighbors complain about the dog. He is howling and whining. I am buying a book, *How to Train Your Dog.* My neighbors are so unfriendly [weeps]. Do you have any suggestions? (573–574)

Unfortunately, Dr. Heiman was unable to provide her with the information and support she sought, leading her to break down with a mixture of angry accusations and tears.

Worry and Guilt: The Human Dimension of Separation Distress

The comments expressed by Dr. Heiman's patient are common concerns among clients presenting dogs with separation-distress problems. Barking problems may result in nasty complaints from neighbors or even costly citations, destructiveness may cause thousands of dollars of damage to household property, and periodic house soiling causes untold frustration. But not only are owners likely to be highly distressed by the trouble and costs resulting from their dog's separation reactivity, they may experience numerous inconveniences as the direct result of attempting to manage their dog's separation problems. There is a tremendous amount of worry expended in response to separation problems, leading one to consider whether the term *separation anxiety* might not better be reserved to describe how the owners feel when they leave their problem dogs behind. The lives of such owners are often profoundly impacted by the problem, causing them to alter daily routines and limit outside interests in an effort to minimize their dog's exposure to separation distress. As a result, a complex mix of conflicted feelings, dilemmas, and resentment may daily stir a caldron of growing impatience and anger toward the dog. At one moment, owners may feel victimized and helpless, while, at the next, they may experience feelings of bitter resentment and anger about their dog's misbehavior. This turmoil may cause them to respond irrationally or explosively toward their separation-distressed dogs, sometimes causing them to resort to harsh and futile retroactive punishment in an effort to solve the problem (see the discussion below). Such punishment does not do dogs any good and may actually make the problem much worse. When owners of separation-anxious dogs finally turn for help, they are often desperate and impatient for relief. Unfortunately, treating such problems is often time-consuming and difficult—unwelcome news to owners who are already at their wits' end or secretly considering the possibility of giving their dog up.

Separation anxiety is a quintessential cynopraxic problem. The central issues at stake involve modifying the social bond between owner and dog to enhance their relationship, while at the same time raising the dog's quality of life and its sense of well-being. Balancing these interests will naturally result in improved dog behavior, while restoring the owner's affection and attachment toward the dog. Many owners seek help in a state of exasperation and only after having tried what they believe to be everything. More often than not, it is clear that they have received bad or incomplete information. It is of utmost importance to gain the owners' confidence by offering them, first and foremost, sincere support and understanding (see *Cynopraxic Counseling* in Chapter 10). The next step is to assess the problem, develop a working hypothesis, and make various behavioral recommendations. These efforts should be realistic and matched as closely as possible to each owner's capabilities and circumstances.

Behavioral Expressions of Separation Distress

Dogs exhibit three general patterns of behavior in response to separation from their owners. By far the most common response is resignation and patient waiting for the owners to return home. It is truly amazing how well so many millions of dogs cope with the daily drudgery and emotional strain of loneliness and boredom (Figure 4.4). The next group

FIG. 4.4. Many dogs spend much of their time anxiously waiting for their owners to come home. (Photo courtesy of V. L. Voith.)

encountered in large numbers includes those dogs who fall into a pronounced state of ennui or depression. These dogs appear to be held in a state of suspended animation. They do not move around much during their owners' absence and may refuse to eat or drink until they return home. They will sometimes howl or vent doleful and haunting moans—vocalizations expressing pronounced loneliness. Depression (reduced activity levels) in response to separation may serve an adaptive function by conserving energy and by reducing the chance of being detected by an enemy, thus making survival during long periods of separation more likely. Under adverse conditions, separation-depressed dogs may become progressively anxious and reactive. The third group, and the most commonly presented for training and behavior modification, exhibit signs of intense arousal, agitation, and behavioral activation (McCrave, 1991; Voith and Borchelt, 1996).

Some anaclitic or psychologically dependent dogs appear to *obsess* over their owners' whereabouts, following their *person* from room to room like a tireless shadow, whereas other dogs may exhibit more or less normal proximity-seeking behavior, at least until their owners prepare to leave the house. Dogs exhibiting separation distress often show signs of predeparture arousal and worry (e.g., restless, shaking, and whining) elicited by the owner's preparations to leave (Podberscek et al., 1999). Some dogs may engage in various efforts to forestall or prevent the owners' departure. For example, they may refuse to come or resist entering their crate or other areas used for confinement. In other cases, probably involving a strong element of frustrative arousal, dogs may threaten or even attack their owners in an effort to prevent them from leaving. Not only is increased arousal evident prior to leaving, separation-reactive dogs are also more likely to engage in intrusive and noisy greeting rituals, at which times they may repeatedly jump, run about, and bark, appearing to find it difficult to control their enthusiasm and *arrival elation* (Voith and Borchelt, 1996). Interestingly, many otherwise highly reactive and separation-anxious dogs may tolerate being left alone in a car without becoming overly distressed (Figure 4.5), but others may become reactive and potentially destructive to upholstery.

When separated from their owners, separation-reactive dogs may become highly agitated and exhibit various activities evidencing heightened distress or panic, such as becoming increasingly active and worried in appearance, pacing back and forth, looking out windows, and sniffing or scratching at doors. In addition, they may glance off countertops and furniture, all the while appearing to obsess over the whereabouts of their absent owners. After

FIG. 4.5. Many dogs that cannot tolerate being left alone at home do well when left in a car. (Photo courtesy of V. L. Voith.)

a period of escalating activity, they may whine, followed by yelping and barking, and, finally, some may lapse into a panic of self-absorbed and persistent vocalization, pacing, and frustrative efforts to escape. These various attempts to restore contact may continue, off and on, for hours on end. Some separation-reactive dogs may pull pillows from sofas and chairs or target personal belongings like clothing, books, magazines, and television remote control devices—anything that might yield an ersatz connection with the absent attachment object. Separation-reactive dogs may lose bowel or bladder control—sometimes eliminating on furniture or beds. In fact, many house-soiling problems in adults dogs have been traced to separation anxiety. Of 105 cases of house soiling reported by Yeon and colleagues (1999), 39% of the dogs treated exhibited signs of separation anxiety. Another common sign of separation distress is evidence of excessive salivation at the base of the door or on the crate floor. Additionally, separation-reactive dogs may present symptoms of psychosomatic illness, including anorexia and diarrhea (Schmidt, 1968), with long-term separation distress possibly exerting deleterious stress-related effects on the animal's immune system (Coe et al., 1985; Ornitz, 1991; McMillan, 1999). Orphaned children have been reported to suffer various emotional and physical disturbances (even death) as the result of long-term hospitalization, where they receive inadequate maternal care, contact, or stimulation [e.g., Spitz (1946)]. Dogs not exhibiting separation-anxiety distress may also exhibit some of these problems, so it is important to exclude other potential causes as part of the assessment process (Table 4.1).

ASSESSING SEPARATION-RELATED PROBLEMS

Separation distress is a common complaint presented to animal behavior consultants and trainers. Borchelt (1983) reported that from 1978 to 1981 he diagnosed 146 cases involving separation anxiety. This figure represented 39% of his caseload during that period. Other estimates have placed the incidence of separation-related problems at approximately 20% of the behavioral cases treated (McCrave, 1991). When presented with a behavior problem that only occurs in an owner's absence, separation distress, in one of its various forms, should always be considered as a possible cause. Most dogs experience some degree of distress when left alone, but a few experience very pronounced panic shortly after their owners leave the house, usually reaching a peak within 30 minutes or so after separation (Voith and Borchelt, 1985). As already noted, there appears to exist two general and opposing affective states associated with heightened separation distress. Some dogs become highly aroused, a state associated with panting, pacing, various distress vocalizations (including whining, barking, and howling), increased seeking and exploratory behavior, destructiveness, and loss of bowel and bladder control. As already noted, other dogs become depressed and simply lie down waiting forlornly for their owners to return home. Scott and colleagues (1973) early on recognized these two opposite tendencies resulting from separation distress and noted their respective roles in the development of behavior problems:

> That such a motivational system exists in the dog can be verified by any dog-owner who attempts to go away and leave his pet or to shut it up away from human beings and other dogs. Many animals in the latter situation become frantic, leaping at the door and gnawing on the woodwork. Or, if the dog belongs to an easily

TABLE 4.1. Separation-related Behavior Problems

Elimination	Destructiveness	Vocalization
Behavior Urination Defecation	*Behavior* Chewing Scratching Digging	*Behavior* Barking Whining Howling
Occurrence Owner absent Dog denied contact with owner	*Occurrence* Owner absent Dog denied contact with owner	*Occurrence* Owner absent Dog denied contact with owner
Significant signs Predeparture distress Exhibits pre- and postdeparture distress Elimination often occurs within first 30 to 60 minutes after departure Occurs with a high percentage of departures	*Significant signs* Destructiveness often directed toward personal belongings, doorjambs, and carpeting near doorways Exhibits pre- and postdeparture distress Destructiveness often occurs within first 30 to 60 minutes after departure Occurs in a high percentage of departures	*Significant signs* Vocalization may occur at various times during the day Exhibits pre- and postdeparture distress Vocalization often occurs immediately or within first 30 to 60 minutes after departure Occurs in a high percentage of departures
Differentiate Housetraining problems Fear-related elimination Excitement/submissive urination Urine marking	*Differentiate* Playful or exploratory destructiveness Destructiveness related to fear (e.g., thunder phobia) Related to external sources of stimulation (e.g., passing cat or dog) Hyperactivity	*Differentiate* Related to external sources of stimulation (e.g., presence of other dog, animals, passersby, deliveries) Vocalization occuring in response to fear-eliciting stimulation Occuring in reponse to other dogs barking Hyperactivity

> inhibited breed, like the Shetland sheep dog we once owned as a pet, it may simply lie down in one spot and wait there until its owner returns, with a resigned lack of interest in anything around it. In common language, a dog's strongest and most continuous type of motivation is a desire for companionship, canine or human, and most of the dog behavior problems arise from deprivation of companionship. (11)

Although depressed dogs may be unhappy and discontented, they are not causing any problems and are only rarely presented for behavior therapy. A symptom shared by both groups is a loss of appetite or psychogenic anorexia. Some dogs appear to exhibit *bipolar* symptoms, alternately showing signs of both extremes, depending on circumstances.

Curiously, although the existence of separation distress in dogs has been recognized for many years, little systematic research has been done on the phenomenon until relatively recently. Albrecht (1953) appears to have been the first dog behavior counselor to clearly articulate a connection between excessive vocalization and destructive behavior with separation anxiety:

> As silence settles over the empty house and the old scent of his master tells him that he is alone, he becomes apprehensive and begins restlessly pacing about, whining and sniffing in an attempt to catch a fresh scent or attract the attention of his master. Hearing nothing and finding no reassuring smell, his fear increases. Perhaps the telephone will ring or the doorbell. He always associates these familiar sounds with the answering voice or footsteps of his owner and so he sets up a frantic barking. But his master does not come and an ominous silence again reigns in the house. His barking becomes more hysterical and his restless pacing turns to frantic running about as he hunts for a means of escape. His frenzy increases, and he feverishly attacks any object within his reach and worries it until, if he is alone for a long enough time, he falls into an exhausted sleep with the evidence of his terror strewn around him. *Punishment is useless when his master eventually returns, for the dog's destructive panic is forgotten in his joy and relief at sight and scent of him.* (120, italics added)

Having diagnosed the problem, she then describes a procedure for reducing the separation-distressed dog's anxiety:

> To overcome this fear, you must teach your pet to have confidence that you will always come back to him. While you are at home, shut him in a room for a few minutes and go far enough away for him to be unable to hear you or scent you. After a short time open the door and fuss over him to let him know that you are as glad to see him as he is to see you. Repeat this several times a day for a few days, gradually increasing his period of solitude until he can be safely left alone for several hours. If you are always genuinely glad to see him when you return, he will not in any way connect his confinement with punishment or desertion; and in a week or so, unless he is an extremely shy and unstable animal, he will curl up and sleep knowing that you will com back to him. (120–121)

Albrecht's contribution is an important one, but, since then, several articles have appeared in the veterinary literature on the topic, confirming the efficacy of the general method and offering many additional insights and techniques for the management of canine separation distress. Unfortunately, however, besides the seminal clinical work reported by Hothersall and Tuber (1979) and its further development and dissemination by Voith and Borchelt (Voith, 1980, 1981; Borchelt and Voith, 1982; Borchelt, 1983; Voith and Borchelt, 1985, 1996), little else of substance has been done to significantly broaden our understanding of the disorder and its treatment.

As already discussed, separation-related distress may be augmented by a number of motivational factors. Perhaps, as the result of early traumatic experiences or genetic predisposition, separation distress may coalesce with fear and gradually incubate into an adult global panic response at separation. Dogs exhibiting storm phobias and other fears elicited by stimuli likely to occur in the owner's absence may be susceptible to increased fear at separation. The development of separation-anxiety panic problems may be related to the presence of learned helplessness or excessive dependency on the owner for a sense of security. This sort of separation reactivity is clearly an anxiety-type disorder, but not all separation-related problems are due to a fear of separation and maladaptive panic. Many separation-reactive dogs do not appear to be motivated in the first place by a fear of separation but rather by frustration resulting from thwarted efforts to gain contact with the absent owner. Other dogs may simply have a low tolerance for boredom and an equally low threshold for boredom-related diversionary exploration and other activities aimed at obtaining optimal stimulation in the owner's absence. Such behavior is especially prevalent in breeds bred for high activity levels (e.g., sporting, working, and terrier breeds). Frustration and boredom have considerable overlap and motivational coactivity. Dogs that have a history of unresolved destructive behavior or have received excessive and ineffective interactive punishment as the result of stealing personal belongs or engaging in other oral excesses (e.g., mouthing or biting on hands and clothing) may resort to such behavior when agitated with separation distress. Clearly, frustrative-arousal and boredom-triggered activities play significant roles in the expression of separation-related behavior problems.

Diagnostically delineating separation-anxiety panic from separation frustration or separation boredom is not always easy. Some

dogs may exhibit all four contributory elements: fear of separation, panic, frustrative arousal, and boredom. Others may exhibit a genuine fear of separation and an equally strong frustrative response to being left alone. Then there are those that are primarily motivated by frustration and that panic when they are unable to obtain contact. Active and helpless dogs (exposed to a pattern of retroactive punishment) may be particularly prone to separation-frustration panic problems, exhibiting frenetic and disorganized behavior (panic) when left alone. Even when a dog appears to exhibit clear signs of anxious arousal in response to its owner's preparations to leave, this behavior is not always positive proof of separation anxiety or fear. Askew (1996) has argued that in such cases *attention-getting behavior* routinely exhibited and reinforced prior to the owner's departure may be misconstrued as predeparture anxiety. Although fear certainly presents coactively with separation distress (e.g., the storm-phobic dog is prone to develop separation-anxiety panic problems), the role of fear in the development of separation-related problems is far from clear.

ETIOLOGIES, ETHOLOGY, AND RISK FACTORS

The predisposing and causal factors underlying separation-distress problems have not been fully worked out, but several prominent influences have been tentatively identified. Of first importance is the dog's proclivity to form strong and lasting attachments with humans and to remain dependent on human care throughout its life cycle.

Miscellaneous Causes and Risk Factors

Episodes of increased separation distress are often observed after an abrupt change of social or environmental circumstances (Borchelt and Voith, 1982). Many dogs exhibit their first episode of separation distress after being suddenly exposed to a period of separation following several weeks or months of near-constant contact with their owners. Frequently, dogs, that had been well adjusted to being left alone, are thrown into a crisis of separation distress after the family moves into a new home, marking the onset of separation-related problems. Any abrupt change in daily routine and place may be more than predisposed dogs can handle. Some owners have noted heightened reactivity to separation in their dog after a lengthy period of boarding. Separation-reactive dogs are often highly sensitive and may present with various collateral fears and phobias, especially fears of loud noises and thunderstorms. In addition to fear and panic, frustration plays a significant motivational role in the expression of separation distress.

Although Wright and Nesselrote (1987) reported finding no significant difference between male and female dogs with respect to the incidence of separation-related problems, more recent studies have indicated that male dogs tend to present with separation problems more often than do female dogs (Podberscek et al., 1999; Takeuchi, 2000). Curiously, mixed-breed dogs appear to be significantly overrepresented in the canine population exhibiting separation-related problems. Statistical comparisons between purebred and mixed-breed dogs reveal that the most significant factor differentiating the two groups is their source: mixed-breed dogs are more frequently obtained from shelters than purebred dogs (McCrave, 1991). One explanation that has been proposed to explain the larger number of shelter dogs presenting with separation distress is that such dogs may be predisposed to develop such problems as the result of traumatic experiences associated with shelter relinquishment (Borchelt, 1983). Another possible explanation for the disproportionate representation of shelter dogs in this population is that owners of separation-anxious dogs may "dump" them on to the shelter system rather than treating the problem or having the dogs euthanized. In other words, the apparent higher incidence of separation-related problems in dogs acquired from a shelter may be due to the shelter system inadvertently recycling dogs with untreated separation anxiety (Van der Borg, 1991). Both of these explanations are probably at work, however. Relinquishment does involve some experience of traumatic loss for dogs, perhaps predisposing them to form an overly dependent attachment with the adopting

owners. Further, dog owners may choose to relinquish mixed-breed dogs with separation-related behavior problems rather than seek costly behavior therapy and training or find new homes for their problem dogs. Finally, Mugford (1995) found that, among 220 dogs presenting separation-related problems, only 10% of the purebred dogs came directly from breeders, with the majority (55%) of them coming from "puppy mills" or similar places; unfortunately, he fails to define exactly what he means by a *puppy mill.* He speculates that early exposure to traumatic handling/transportation or inadequate sensory and social stimulation during a puppy's first 6 to 8 weeks of life may be involved in the development of adult separation-distress problems.

Unlike aggressive dogs, which are often destroyed, separation-distressed dogs usually escape euthanasia. For one thing, such dogs may be relinquished without mention of their separation problems, with owners making excuses for their dog's behavior like "not enough time" or "the dog needs more attention or space." The affectionate and outgoing enthusiasm of separation-reactive dogs may make them appealing to prospective owners, in comparison to less enthusiastic and retiring dogs competing for the attention of prospective adopters. Without treatment or training, separation-reactive dogs are recycled into new families, and the pattern is repeated until the dogs receive appropriate training or their luck finally runs out. Based on recent statistical studies, Tuber and colleagues (1999) estimate that 20% of the shelter population consists of dogs previously adopted and subsequently relinquished back into the shelter system, many as the direct result of behavior problems. In Europe (The Netherlands), the return rate has increased from 19% in 1983 to 50% in 1991 (Van der Borg et al., 1991).

Attachment, Proximity Seeking, and Family Size

Many dogs appear to develop separation problems as the result of forming excessively strong or exclusive bonds with one person. Clarifying the influence of owner attitudes and attachment levels on the development of separation distress is an important area of research. Surprisingly, in this regard, Voith and colleagues (1992) were unable to find a statistically significant relationship between anthropomorphic attitudes or spoiling activities and an increased occurrence of behavior problems. Further, Voith (1994) was unable to show a statistically significant difference between dogs diagnosed with separation anxiety and others not exhibiting the problem, in terms of whether they followed their owners about the house. Of these dogs (N = 100), 36 were diagnosed with separation anxiety, 64 were judged not to be exhibiting separation anxiety, and 3 presented ambiguous signs. Although the general tendency to follow the owner does not appear to be a reliable diagnostic indicator of separation anxiety, many separation-reactive dogs do exhibit pronounced proximity-seeking behavior toward their owners, especially at times immediately preceding owner departures.

Voith's findings question the importance of attachment levels as a predictor or causal factor in the etiology of separation anxiety. The literature on this issue is somewhat conflicted, however. Jagoe and Serpell (1996), for example, detected a significant relationship between sleeping in the owner's bedroom (a proximity measure) and an increased incidence of separation-related elimination problems, but emphasize that their data are inconclusive with respect to determining "whether the behavior problems are the consequences or the cause of the sleeping arrangement" (40). The strongest evidence to date questioning the role of attachment levels as a significant factor in the etiology of separation problems was reported by Goodloe and Borchelt (1998). Among 2018 dogs whose owners responded to a highly detailed questionnaire, the researchers found that measures of attachment, defined as efforts to maintain close proximity to the owner, showed no significant correlation with separation vocalization. They concluded that "panic at separation is not necessarily related to strong attachment. . . . Both humans and dogs can be strongly bonded to other individuals without experiencing anxiety or panic in their absence" (330). Nonetheless, many practitioners still believe that attachment levels play a significant role in the development of separation-related problems.

Although attachment per se may not always be a significant factor in the development of separation-distress problems, the quality of attachment, that is, the degree of dependency (anaclisis) versus secure attachment, may exert a significant influence (Clark and Boyer, 1993). Many separation-reactive dogs do, in fact, exhibit an exaggerated psychological dependency and anxious attachment toward their owners. They may appear insatiable for attention, exhibiting a constant desire for affection or need to maintain close physical contact, appearing uncomfortable unless they are in the owner's immediate proximity. They may engage in pestering antics or barking whenever their owners are distracted from them. Such behavior may occur when the owner diverts his or her attention away from the dog to use the phone. These demanding and persistent attention needs cause some owners to feel very uncomfortable and oppressed by it all. Some separation-anxious dogs will even refuse to eat unless the owner is nearby.

Despite the uncertainty and paucity of data regarding the influence of family size and structure on separation distress, there exists a general impression that separation anxiety presents most often in dogs living with a single owner or a couple. Recently, Topál and colleagues (1998) reported that dogs living in a large family situation tend to exhibit less separation distress when left alone than dogs living in smaller family groups. Perhaps, in larger family groups, with more people coming and going, dogs are exposed to separation in more safe and gradual ways. Also, large families may provide opportunities for multiple attachments to form, thereby preventing the development of an overly exclusive bond forming with one particular person, whose absence elicits separation distress. In regard to a possible connection between social group size and separation anxiety, Podberscek and colleagues (1999) reported that most of the separation anxious dogs in their study (N = 49) lived in homes with two adults and no children. Finally, the Ainsworth's (1972) strange-situation test used by Topál and colleagues provides an interesting nonintrusive means for evaluating some of the current conflicting hypotheses concerning the role of attachment in the development of separation-related distress.

Separation Distress and Retroactive Punishment

Many owners presenting separation-distressed dogs for training believe that their dog's behavior is motivated by spitefulness or resentment at being left alone. In support of these beliefs, such owners may report various signs of guilt in their dog's demeanor, even before they discover the damage or mess made by the dog in their absence. The dog's appearance of *guilt in advance* is sufficient proof for them that the dog "knows" and is acting in a calculated manner (Vollmer, 1977). The first step in the counseling process is to convince them that their dog's behavior is better understood in terms of separation distress (anxiety, frustration, panic, or boredom) rather than vindictiveness. It is of utmost importance to explain in detail how such appearances of guilt probably result from a history of ineffectual punishment and that what they are observing is not guilt at all but rather apparent guilt or pseudoguilt (see *Misuse and Abuse of Punishment* in Volume 1, Chapter 8). It is also useful to point out that retroactive punishment may only worsen a dog's separation anxiety by enhancing its feelings of helplessness and, paradoxically, by increasing its attachment dependency toward the owner.

The owner may have trouble understanding and accepting the notion that dogs cannot causally connect punishment occurring in the presence of a *destroyed item* (e.g., the damaged sofa) with the *act of destroying it,* that is, behavior occurring at some in the past. But even the most resistant owner can be shown the dog's inherent limitations in this regard through thoughtful counseling. One method is to explore some of the differences in the way humans and dogs process, organize, and represent information. Appealing to the human's unique ability to think and symbolically represent experience through concepts and words provides a starting point from which to compare the dog's relative limita-

tions with our own capabilities. It can be explained that humans can conceive of past events in terms of causal relations having deterministic effects on present events, largely as a result of our unique conceptual ability to symbolically represent and relate objects, events, and relations to one another. In addition, it should be emphasized that a dog's appearance of guilt is not an expression of remorse aimed at placating the owner about some past action but rather represents a fearful-submission display aimed at avoiding punishment in situations where it has occurred in the past, regardless of its association with the unwanted target behavior. This theory holds that pseudoguilt is maintained by a triad of conditioned associations involving the following elements (Borchelt and Voith, 1985):

- Evidence of a destroyed object or soiled area.
- The presence of the owner.
- A history of punishment under similar circumstances in the past.

Another scenario involves the possibility that separation distress itself becomes associated with belated punishment as an internal cue. According to this theory, a dog is destructive or eliminates only when it is under the influence of high levels of separation distress; that is, a dog may identify an increased probability of punishment with those occasions when it is particularly upset during separation, coincidentally those same times when destructiveness or elimination is most likely to occur in the owner's absence. This account could help to explain why some dogs appear to show guilt *before* the owner actually finds the evidence of misbehavior. The triad of associative elements in this case includes

- The dog feels distressed.
- The owner returns home.
- The dog has been punished in the past when it felt distressed.

Determining the various causes of pseudoguilt in dogs would provide valuable information. At this point, the debate concerning the causation of pseudoguilt revolves around little more than speculation and educated guesses. Unfortunately, these views have not been experimentally tested. Many anecdotal reports, however, are very supportive of a pseudoguilt interpretation. For example, it is not uncommon for an adult dog that is kept with a puppy during owner absences to exhibit guilt at homecomings, especially on those occasions when the puppy has been destructive or eliminates while the owner is gone.

Aging and Separation-related Problems

A higher incidence of separation problems is observed in older dogs. Chapman and Voith (1990) found that half of 26 older dogs studied (mean age, 12.2 years; and range, 10 to 18 years) were diagnosed with separation anxiety. Milgram and colleagues (1993) studied the degenerative effects of aging on a dog's nervous system and behavior. Older dogs appear to undergo many of the same neurological and behavioral changes that are suffered by elderly people, including evidence of progressive cognitive dysfunction and degenerative brain disorders. In addition to performing basic research, members of Milgram's group have also evaluated the clinical and behavior effects of L-deprenyl (selegiline) on age-related symptoms presented by older dogs (Ruehl et al., 1995). They found that L-deprenyl appeared to enhance cognitive functioning in many of the geriatric dogs treated. As many as 62% of the dog population over 10 years of age may exhibit some sign of cognitive dysfunction (E. W. Kanara, 1998, Pfizer Animal Health Company). Collectively, these various neurological and behavioral changes are referred to as canine cognitive dysfunction syndrome (CCDS). According to K. A. Houpt (AVMA Press Release, 1996), increased susceptibility to separation anxiety and other emotional disturbances in older dogs are related to CCDS and other discomforts associated with aging. She has reported early successes using L-deprenyl in conjunction with behavior modification for the treatment of separation-related problems in older dogs.

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5

Excessive Behavior

Persistence depends on inconsistent treatment of consistent behavior.

ABRAM AMSEL (1971)

PART 1: COMPULSIVE BEHAVIOR

Many compulsive and ritualized habits have been identified in dogs, including compulsive eating (hyperphagia), pica, excessive licking (directed toward the floor, furniture, and hands), rooting at food, digging, mounting, barking, pacing, fence running, and various aberrant aggressive displays. Some affected dogs suffer psychogenic dermatoses, compulsively licking lesions into their limbs and feet [acral lick dermatitis (ALD)]; others monotonously suck on their flanks [a habit most common among Doberman pinschers (Figure 5.1)]; and some appear mesmerized by phantom flies or may lunge and snap at flecks of light on a wall. Dogs taken too early from their mother are prone to develop compulsive, stereotypic habits involving blanket sucking and kneading—a compulsion frequently not appearing until after puberty. Finally, there is a tendency for certain breeds to present compulsive problems more often [e.g., bullterriers and German shepherds (whirling-tail chasing) and Labrador retrievers (ALD)], suggesting a probable genetic factor predisposing some dogs to develop such habits.

DEFINITIONS

Compulsive behavior disorders (CBDs) in domestic animals have received growing attention over the past several years. Some

FIG. 5.1. Flank sucking is a compulsive behavior that is primarily exhibited by Doberman pinschers. (Photo courtesy of V. L. Voith.)

authors have unfortunately borrowed the psychiatric term *obsessive-compulsive disorder* (OCD) in describing the analogous conditions observed in dogs (Luescher et al., 1991; Overall, 1992a–c). This appropriation of terminology is apparently intended to emphasize the close similarity between human OCD and the stereotypic rituals and compulsive repetitive behavior exhibited by domestic animals. Rapoport and Ismond (1996) define *obsessions* in their *DSM-IV Training Guide for Diagnosis of Childhood Disorders* in the following way:

1. Recurrent and persistent thoughts, impulses, or images that are experienced, at some time during the disturbance, as intrusive and inappropriate and that cause marked anxiety or distress.
2. The thoughts, impulses, or images are not simply excessive worries about real-life problems.
3. The person attempts to ignore or suppress such thoughts, impulses, or images, or to neutralize them with some other thought or action.
4. The person recognizes that the obsessional thoughts, impulses, or images are a product of his or her own mind (not imposed from without in thought insertion). (230)

Although dogs may "obsess" like humans suffering with OCD, the possible role of obsession cannot be confirmed by direct report or quantified by any other scientific method currently available. Therefore, to refer to compulsive behavior exhibited by animals as obsessional is both excessively anthropomorphic and possibly misleading. Consequently, the term *compulsive behavior disorder* (Fox, 1963) is used in the following discussion to avoid such confusion.

Stereotypic rituals and compulsive repetitive behaviors are commonly seen in zoo and laboratory animals confined to spaces inadequate for their needs. Such animals can often be observed engaging in various *stereotypies,* including monotonous rhythmic pacing, rocking (chimpanzees), circling, excessive self-grooming, or various nonnutritive consummatory behaviors (e.g., pica). Since compulsive behaviors frequently occur in response to elevated arousal levels, especially as the result of frustration, it has been suggested that such behavior may serve a de-arousal function. In fact, several studies in humans and domestic animals have shown that compulsive repetitive behavior decreases heart rate (Seo et al., 1998). Some compulsive behaviors appear to involve aggressive behavior redirected toward the animal's body, often causing self-injury (Jones and Barraclough, 1978). Frustrative arousal is an establishing operation for aggressive behavior, supporting the notion that self-directed attacks may involve an aggressive motivation.

Compulsive repetitive behaviors are often referred to as stereotypies. Kuo (1967), however, has charged that strictly speaking stereotypic behaviors do not exist:

> No animal responds twice to the same stimulation in exactly the same way. The pacing back and forth of a fox or a wolf in the zoo may appear to the onlooker to be stereotypical. But if one takes quantitative measurements of the pacing movements of the animal one will find that no two pacing movements cover the same ground, involve the same neuromusculature, consume the same amount of energy, and have the identical implicit gradients [that is, internal motivational organization]. (100)

It is important, therefore, to declare at the outset that when the term *stereotypy* is used here, it is employed in a less formal sense than suggested by Kuo and denotes a high degree of regularity, repetitiousness, and inflexibility.

The term *stereotypy* refers to a relatively invariant pattern of compulsive behavior, usually occurring under unnatural conditions, involving varying degrees of distress (e.g., conflict and frustration). *Stereotypies* usually consist of ordinary behaviors (e.g., appetitive, self-grooming, and locomotor activities) that occur out of context, in excess, or in an exaggerated form. The specific elements making up the *stereotypic* ritual consist of repetitive compulsive behaviors that intrude and interfere with normal activities or cause physical injury to the animal (e.g., automutilation). Finally, stereotypies have species-typical relevance and present similar forms in animals belonging to the same species. For example, crib biting (cribbing) is a common stereotypy observed among distressed horses. Affected animals engage in persistent and compulsive biting on wooden stalls and fence posts while simultaneously sucking in air. Dogs do not exhibit cribbing, but instead may lick sores into their carpus or mutilate their tail as the result of chasing it. Although stereotypies may serve a similar function in both species, the stereotypic forms expressed by the two species are different.

Etiology

The etiology of compulsive behavior in dogs is not fully understood; however, several prominent risk factors have been identified. Compulsive behaviors are most frequently reported in dogs that have been stressed by excessive confinement, exposed to sensory-motor deprivation (e.g., boredom and inadequate exercise), provided inadequate social attention and stimulation, or exposed to a conflict-dense environment. Stereotypic behavior patterns may develop as the result of neurobiological stressors; for example, hyperkinetic dogs under the influence of long-term amphetamine treatment may exhibit chomping behavior or spontaneous barking. Also, compulsive symptoms often appear in highly excitable or nervous dogs where no identifiable external precipitating causes or stressors can be identified, suggesting that a genetic predisposition may underlie the etiology of some compulsive behavior disorders. Once established, the frequency and range of contexts under which compulsive behavior occurs may increase and widen over time, making early diagnosis and treatment imperative (Hewson and Luescher, 1996).

Environmental Deprivation and Distress

Dogs may exhibit compulsive behavior when overly confined or deprived of adequate exercise, social contact, or sensory stimulation. Melzack and Scott (1957) reported the case of several 9-month-old Scottish terriers that had been exposed to 7 months of almost total sensory and social isolation (initiated at 4 weeks and terminated at 8 months of age). The dogs exposed to restricted rearing conditions exhibited a variety of motor deficits, increased excitability, and disorganized "wild, aimless" behavior. They also exhibited sharp differences in comparison to normally reared controls in terms of avoidance learning. When tested for nociceptive responsiveness, isolated dogs repeatedly approached the flame of a match even though they were burned by it again and again. Long-term restriction and social isolation have been implicated in the development of compulsive whirling and circling behavior by dogs (Fisher, 1955). Thompson and coworkers (1956) found that, among 11 Scottish terriers reared under restricted conditions, 8 developed the habit of whirling, together with intense vocalization, tail biting, and snarling—all lasting for up to 10 minutes at a time. Some breeds appear to be predisposed to develop the whirling compulsion. The English bullterrier, for example, is particularly prone to develop a serious whirling disorder with automutilation (Dodman et al., 1993; Blackshaw et al., 1994). Also, Hewson and Luescher (1996) note that German shepherds present relatively more often with the habit, but tail chasing and tail biting occur in a variety of breeds (Figure 5.2).

Vacuum Behavior

How is such behavior to be interpreted? Early ethologists proposed that such behavior might be viewed as a form of *vacuum behavior*. Vacuum behavior occurs under conditions of close confinement in which various drive pressures (including aggression) may gradually

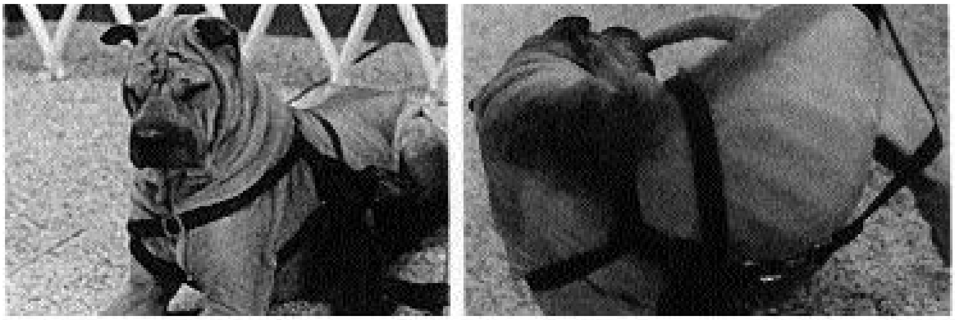

FIG. 5.2. This shar-pei appears to have difficulty staying awake, a sign that may reflect an underlying conflict or fear condition (Voith and Borchelt, 1996). When aroused, the dog turns and bites its tail. (Photos courtesy of V. L. Voith.)

build up and be triggered by objects and stimuli other than normal ones. Such behavior occurs especially in situations where normal outlets and opportunities for appropriate drive-reducing activity are not present. Vacuum behavior appears to spontaneously erupt out of frustrated internal drive tensions unable to find adequate expression otherwise. When vacuum behaviors are motivated by aggression, they frequently take the form of whirling topographies, with the aggression being directed at the animal's body (Lorenz, 1981). Whirling in dogs, therefore, may not be an entirely neutral motoric compulsion but an aggressive vacuum behavior directed at the animal's own body. This interpretation is consistent with the description of whirling given by Thompson et al. (1956) and others:

> Whirling can be described as follows: very rapid, jerky running in a tight circle; shrill, agonized yelping; barking and snarling; and tail snapping and tail biting. The syndrome may last from 1 to 10 minutes. It is usually heralded by certain characteristic signs. The dog suddenly becomes motionless, cocking its head up and back, as if looking at its own tail. It begins to growl viciously, and its eyes take on a glazed expression. These signs may continue for a minute or two, increasing in intensity until the full-blown fit occurs. (939)

Swedo (1989) proposes that compulsive behavior may be the result of a dysfunctional releaser and fixed-action pattern (FAP):

> Obsessive-compulsive rituals can be viewed as inappropriately released fixed-action patterns. Our work with more than 200 children and adults has led us increasingly to view OCD in this fashion. For example, obsessive patients, who check and recheck that the coffee pot is unplugged, all seem to perform each checking pattern in an identical fashion. Their behavior is perfect in form, but after the first check, it is ineffectual and inappropriate. To follow an ethological model, one must of course, ask: what is the releasing stimulus in OCD? Is it internal (e.g., chemical) or external (e.g., environmental stress)? How does it effect the release of the ritualized fixed-action pattern? (273)

Given the relatively narrow range and specificity of compulsive behavior disorders, it makes sense to interpret them in terms of species-typical adaptations to persistent frustration or conflict. Under the stressful influence of adverse frustration or conflict, a *releaser* mechanism may become defective, causing predisposed dogs to inappropriately repeat the same rigid and perseverating loop of behaviors. Pathological compulsive behavior appears to operate independently of voluntary control and normal expectations. Like *instinctive* behavior, compulsive habits become progressively ritualized, stereotypic, and automatic—features consistent with an FAP interpretation.

Normal versus Abnormal Compulsions

Under extreme and adverse environmental conditions, it is reasonable to ponder whether such behavior is truly aberrant or simply an adaptive response to an aberrant environment, Mugford (1984) writes regarding this diagnostic dilemma concerning whirling behavior:

> A heterogeneous species such as the dog, raised in a multitude of environments and social situations, presents even greater variability [than a laboratory mouse]. Thus, one generalizes about the behaviour of cats and dogs at one's peril, and the greater one's knowledge of the two species, the less appropriate seems the term "abnormal." For instance, "whirling" is a commonly occurring stereotype in kenneled dogs, but is unusual in free-roaming or home situations. If one examines the behavioural options available to a kenneled dog, one finds that restricted movement and reduced social contacts have made whirling a highly appropriate behaviour in this environment. It brings vestibular stimulation and attention from kennel staff, and in that setting is certainly not an abnormal behaviour. (134)

According to Fox (1974), many compulsive compensatory behaviors may be aimed at resolving internal conflict or other states of anxious arousal:

> If the environment does not provide varied stimulation, the subject may compensate by creating its own varied input by elaborating stereotyped motor acts or by directing specific activities toward inappropriate objects (such as copulating with its food bowl). The stereotyped motor acts (thumb-sucking, self-clutching, and rocking in primates) developed while in isolation may be performed when the subject is in a novel environment and may serve to reduce arousal or anxiety because they are familiar activities and may be comforting. (72–73)

Hewson and Luescher (1996) argue that most compulsive behaviors can be traced to conflict situations involving a high degree of frustrative arousal. Subsequently, the behavior may be "emancipated" from the original context and be expressed in other situations, when the dog is under the influence of increased excitement or stress. Obviously, drawing a definitive line is difficult when it comes to labels like "normal" and "abnormal."

Displacement Activity

Classical ethologists interpreted and described compulsive repetitive behavior in terms of displacement activity. Displacement activity occurs when some course of action is thwarted (frustration) or when two opposing motivational tendencies are elicited at the same time (conflict). Under the influence of frustration or conflict, a substitute behavior may be emitted, often coming from a remote functional system and possessing little apparent motivational relevance for the conflict at hand. A classic example of such substitutive displacement behavior was observed by Tinbergen (1951/1969) in male sticklebacks. These fish are highly territorial and actively defend their nests from the invasion of conspecifics. However, if two male sticklebacks encounter each other on the boundary line between their respective territories, two antagonistic drives may be simultaneously induced. As a result, equally strong fight and flight drives are activated at the same time, resulting in approach-avoidance conflict. The resulting conflict is resolved when the two fish resort to digging behavior—a functionally remote species-typical displacement activity. While digging, sticklebacks point their heads downward and dig into the sand with their mouths as though making a nest. Interestingly, if male sticklebacks are forced to nest too closely together, "they will show nearly continuous displacement digging and the result is that their territories are littered with pits, or even become one huge pit" (117). According to Lorenz (1981), among animals, displacement activities are common everyday occurrences that are specific to particular conflicts and no others; that is, conflict situations among most animals and birds are highly stereotypic, producing only one displacement activity or "sparking over" action pattern.

Under conditions of behavioral or emotional conflict, requiring that a dog choose between two equally unacceptable courses of action, substitutive behaviors or *displacement activities* may help to restore balance and homeostasis within a behavioral system threatened by invasive anxiety or even (in the case of extreme conflict) functional collapse. Subsequently, the displacement activity may be activated whenever the animal is confronted with a difficult or insoluble conflict, providing a mechanism for safely killing time until a more adequate response can be found to resolve the situation. Since the substitute behavior results in the reduction (if only temporarily) of anxiety and the restoration of equilibrium, it may become highly reinforcing

for animals to perform. This may help to explain why CBDs do not extinguish over time, as in the case of other behaviors occurring in the absence of reinforcement. Perhaps the substitute behavior is repeated again and again because it produces strongly gratifying and self-reinforcing effects.

The substitute response is often a behavioral non sequitur; that is, it does not follow from learned expectancies and predictions about the environment but rather represents a behavioral exception evoked under conditions of stress and conflict. The autonomous nature of the CBD gives it the appearance of being irrational, without purpose or apparent goal, and operating independently of normal constraints and inhibitions. Because the substitute behavior does not conform to the ordinary rules of learning, it may be refractory to modification. The substitute behavior is essentially an autonomous anomaly, presenting under the control of variables outside the scope of normal self-regulatory behavioral mechanisms. As a result of their exceptional character and origin, compulsions may exert a *superstitious* or obsessional fascination, further distinguishing them from ordinary behavior.

In fact, many compulsive behaviors appear to take the form of something like a superstition. Lorenz described in detail the behavior of one of his graylag geese that had developed a complex compulsion, apparently driven by anxiety reduction:

> At first, she always walked past the bottom of the staircase toward a window in the hallway before returning to the steps, which she then ascended to get into the room on the upper floor. Gradually she shortened this detour, but persisted in initially orienting towards the window, without, however, going all the way to it. Instead she turned at a 90 degree angle once she was parallel to the stairs. (Quoted in Swedo, 1989:282)

On one occasion, Lorenz forgot to let the goose in at the accustomed time. It was nearly dark outside, and she had become excited about the opportunity to get inside. As a result, instead of going through her typical ritual, she darted directly toward the stair steps and began to climb:

> Upon this something shattering happened: Arrived at the fifth step, she suddenly stopped, made a long neck, in geese a sign of fear, and spread her wings as for flight. Then she uttered a warning cry and very nearly took off. Now she hesitated a moment, turned around, ran hurriedly down the five steps and set forth resolutely, like someone on a very important mission, on her original path to the window and back. This time she mounted the steps according to her former custom from the left side. On the fifth step she stopped again, looked around, shook herself and performed a greeting display behavior regularly seen in graylags when anxious tension has given place to relief. I hardly believed my eyes. To me there is no doubt about the interpretation of this occurrence. The habit had become a custom which the goose could not break without being stricken by fear. (Quoted in Swedo, 1989:282)

This interesting anecdote is relevant to the way in which some common compulsive habits appear to develop in dogs.

Many ritualized habits develop around entryways and boundaries, often becoming extremely energetic and bizarre. For example, a common compulsion among dogs confined outdoors is fence running and fighting (see *Sources of Territorial Agitation: Fences and Chains* in Chapter 7). Sometimes, aggressive behavior is very dramatically increased under such conditions of confinement. Dogs with dog-fighting problems or exhibiting aggression toward strangers often exhibit intensely exaggerated displays while restrained on a leash or chain. In many cases, the aggressive behavior may seem vicious and virtually uncontrollable. Surprisingly, however, if such a dog happens to escape its owner's hold or confinement, the aggressive efforts may almost instantly fizzle out. On recognition that it is free, the previously uncontrollable dog may appear disoriented and confused about its intentions. This is definitely not always the case, though, with many dogs known to deliver particularly savage attacks after breaking free of a chain or slipping a leash. In general, any situation in which a dog is highly motivated to behave in some particular way but prevented from doing so by physical restraint or threat of punishment may increase the likelihood of compulsive behavior.

Adjunctive Behavior and Compulsions

Schedule-induced Excessive Behavior

Many experiments have been performed using intermittent reinforcement and observing confluent effects on behavior, especially exaggerations in drinking, pica, hyperactivity, and aggression (Falk and Kupfer, 1998). In the classic experiments performed by John Falk (1961), rats were trained to lever press on a variable schedule of reinforcement. A small pellet of food was presented on a variable-interval 1-minute schedule (i.e., the rats received reinforcement averaging 1 pellet per minute), so long as they lever pressed at least once between reinforcement opportunities. In addition, the rats were given free access to water. Falk noticed that the rats habitually drank after obtaining reinforcement, usually consuming around 0.5 ml before continuing to lever press. The cumulative result was the consumption of an extraordinary amount of water over the course of a typical 3-hour session. On average, rats drank 90 ml of water, a significant excess of consumption over the normal intake of 27 ml of water consumed by an average rat daily. In other words, the rats drank approximately 50% of their body weight in water during each training session. This phenomenon is referred to as *schedule-induced polydipsia.*

Additional experiments demonstrated that an important factor in the development of schedule-induced polydipsia is the duration of time between reinforcing events. Schedule-induced polydipsia is *time dependent,* with 2- to 3-minute intervals producing the largest magnitude of polydipsia. Shorter or longer intertrial intervals produce less polydipsia or result in normal water consumption. These findings suggest that the phenomenon is controlled by a *bitonic function:* "sessions with either short or long intervals between pellet consumption produce normal amounts of drinking, while intermediate values induce polydipsia" (Falk, 1981:317). Another important variable associated with the phenomenon is deprivation. Rats in Falk's studies were reduced to 80% of their free-feeding body weight. Rats of normal weight are significantly less affected by schedule-induced polydipsia, suggesting that *hunger tension* may influence the phenomenon.

Other forms of adjunctive behavior, including aggression and hyperactivity, have been associated with intermittent reinforcement. For example, a pigeon working on an intermittent schedule of reinforcement may turn and attack a nearby conspecific when the reinforcer is delivered. Although such frustration-related aggression is not uncommon, the magnitude of adjunctive attacks goes far beyond what is normally observed to occur under frustrative conditions (Campagnoni et al., 1986). Similar results have been observed in squirrel monkeys who were maintained on a variable-interval schedule. After receiving reinforcement, the monkey would aggressively grab and bite a rubber hose provided to receive such attacks. Increased activity has also been observed to occur as the result of intermittent reinforcement. For example, wheel running was significantly increased when rats were trained to work under a variable-interval 1-minute schedule of reinforcement.

Food is not the only reinforcer capable of generating schedule-induced excessive behavior. If a well-fed and watered rat is given intermittent access to an activity wheel, several adjunctive behaviors like rearing, licking, and position changes undergo an increase of emission. Studies of people under the influence of variable interval schedules have also shown increases in general activity levels, eating and drinking, and grooming activities. Finally, pica has been observed in animals stressed on brief-interval schedules, suggesting a possible role of schedule-induced motivations underlying the development of such behavior problems in dogs.

Schedule-induced Escape

An average pigeon is willing to work only so long as the schedule of reinforcement stays within certain limits. Rather than work on an exceedingly lean schedule of reinforcement, most animals will opt to press a second key wired to turn off (self-signaled time-out) the reinforcement contingency, even though the action postpones a possible opportunity for

eventual reinforcement. This phenomenon is referred to as *schedule-induced escape.* Paradoxically, pigeons under the influence of food deprivation and weight loss tended to produce the most self-induced time-outs. This is counterintuitive to what one would expect from animals suffering from the effects of deprivation and hunger. An interesting example of schedule-induced escape behavior in dogs was reported by Luescher (1993b). The case involved a 2½-year-old German shepherd that, as a working police dog at an airport, searched planes for explosives. The dog was an enthusiastic and effective detector dog that routinely worked continuously for 1½-hour stretches. However, over the course of a year, his stamina and willingness to perform deteriorated until he was unable to work for periods exceeding 15 minutes at a time. After 15 minutes, he abruptly quit, appeared exhausted, and stood motionless looking at his handler. In addition, the dog developed over the same period a persistent collateral habit of whirling while in the police vehicle (perhaps a compulsion resulting from anticipatory conflict) and had become progressively aggressive toward pedestrians approaching it. The usual search of the plane took approximately 2½ hours, during which time the dog was provided one "successful" find of a dummy bomb, resulting in praise and tug with a toy. Luescher speculates that the schedule of intermittent reinforcement utilized was too lean; that is, the dog was required to search too long for a single reinforcement. He implicates the phenomenon of adjunctive escape as a possible explanation for the dog's behavior. The dog, rather than endure the aversive intermittent schedule, simply quit, even though it meant losing access to the eventual reinforcer:

> Although indicating was reinforced each time in the dog of this report, searching was reinforced as seldom as once in 2.5 hours. Hundreds of sniffing responses may have been performed over a period of up to 2.5 hours, before searching was reinforced by the smell of explosives. Thus, the ratio of nonreinforced to reinforced correct responses was large, and the dog would be assumed to perceive its work as increasingly stressful. . . Because the ride to the airport always preceded the work there, the dog became classically conditioned to associate the ride in the truck with the stressful situation at the airport. The ride thus became a conditioned stimulus, in response to which the dog exhibited increased anxiety. (1539)

Displacement Activities and Compulsions

Falk (1977, 1981) views adjunctive behavior as natural response to equivocal circumstances in which decisive action is not possible. Such behavior may serve an important adaptive function by stabilizing conflict situations involving opposing motivational constraints. He argues that adjunctive behavior is commonly observed in nature when opposing motivational vectors are in equilibrium and *maximally equivocal* (Figure 5.3). These opposing motivations frequently involve defense of territory, feeding, sexual privileges, maternal protection of young, and self-preservation set against the possible need to withdrawal or flee from the situation:

> In terms of evolutionary processes, the adaptive function of adjunctive behavior is to delay commitment to either engaging a situation or escaping from it until one or the other vector becomes clearly ascendent. (Falk and Kupfer, 1998:341)

Among humans, various public rituals typically form around these important transitional cultural and social events (Falk, 1986). When opposing motivations are in approximate equilibrium, action is made uncertain. Under such circumstances, adjunctive behavior or displacement activity emerges in order to temporarily postpone decisive action, thereby preventing a potentially costly mistake. According to this theory, displacement activities stabilize the situation long enough for one of the opposing components to become ascendant and result in a stable resolution:

> The processes that produce displacement activities are precisely those responsible for adjunctive behavior. In both cases, an important activity is in progress or a crucial commodity is being acquired. These are usually territorial defense, courtship and mating sequences, and parental behavior in ethologic studies; scheduled access to food, water, activity, or money in investigations of adjunctive behavior. In one

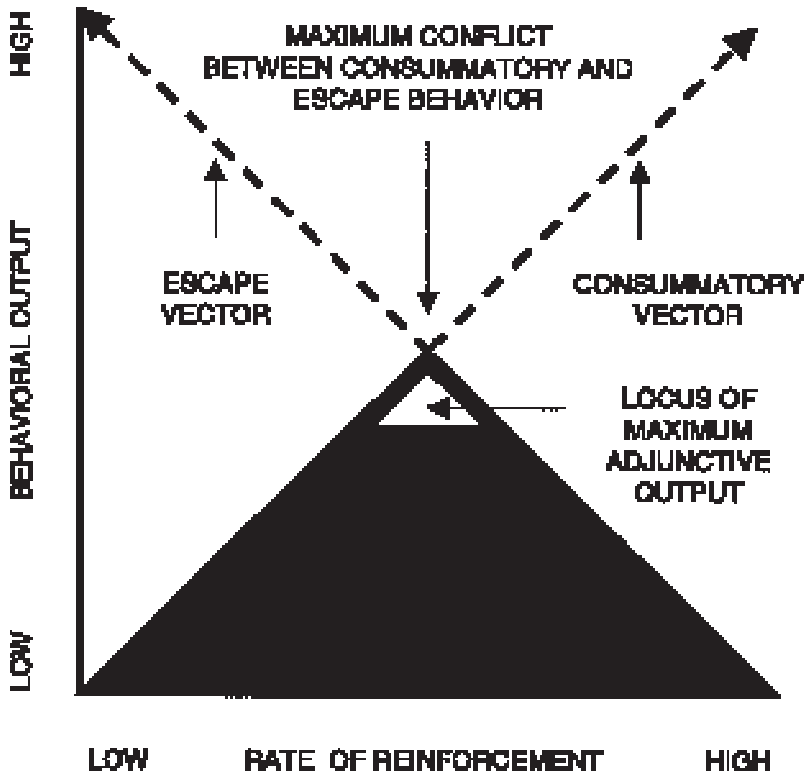

FIG. 5.3. Maximum adjunctive output occurs at the point of highest potential conflict between consummatory and escape vectors. After Falk (1981).

> case the ongoing behavior is impeded by situational interruptions (intruders, inadequate releasing stimuli); in the other, by schedule constraints allowing only episodic access. The resulting behavior is described as incongruous or irrelevant in ethnologic observations and as persistent and excessive in adjunctive behavior investigations. I suggested that displacement activities have evolved because they serve an adaptive function: allowing stabilization of an unclear situation, with a nonprecipitous resolution of competing vectors. . . . Adjunctive behavior, like displacement activities, is behavior that probably serves to block premature escape from nonoptimal situations. For example, a feeding environment providing a marginal amount of food induces a variety of adjunctive activities. In a natural environment, such behavior might function to delay abandonment of a feeding range or patch that, while marginal, is nevertheless adequate. (Falk, 1981:328–329)

There are several obvious implications of Falk's research for the understanding of compulsive behavior. In cases where biologically significant behavior is impeded by environmental constraints evoking opposing motivations of nearly equal strength, one would expect to observe the appearance of exaggerated adjunctive behavior. Adjunctive behavior functions to delay unnecessary retreat from anxious or frustrative arousal, perhaps allowing time for one or the other opposing motivational vectors to assume a definitively dominant influence over the conflict situation. Persistent and excessive adjunctive behavior (compulsive perseveration) results when neither side of a conflict assumes an ascendant role.

Schedule-induced paw grooming (licking) by rats has potential significance for understanding compulsive licking (ALD) in dogs. Lawler and Cohen (1992) observed that some

rats operating under a fixed-time schedule of reinforcement (food was delivered every 2 minutes regardless of an animal's behavior) developed a habit of paw licking. The adjunctive grooming ritual occurred shortly after food was presented and lasted for approximately 30 seconds thereafter. Ordinarily, in rats, paw grooming is a brief initiating segment of a more elaborate grooming activity that includes nose wipes, ear wipes, and overall body grooming. In the case of persistent adjunctive paw grooming, there appears to be a stress-modulating function being performed under the condition of intermittent reinforcement. In the case of canine ALD, the initial increase in self-licking may begin as the result of a similar adjunctive or stress mechanism and then gradually come under the control of various other mechanisms (e.g., the endogenous opioid system), perhaps providing a source of intrinsic reinforcement maintaining the habit.

Conflict and Coactive Factors

Compulsive behavior appears to be most commonly associated with situations where opposing motivational vectors (establishing operations) converge and require that the dog take one of two equally unacceptable courses of action. Given this definition of conflict, dogs are exposed to many conflictual situations in the course of their lives, but relatively few of them go on to develop compulsive habits that require professional intervention. In fact, most dogs appear to adjust to the adversity of conflict and frustration without developing any problems at all. Currently, it is not clear how compulsive disorders develop, but most behavioral theories incorporate some mix of influences, including adverse anxiety, frustration, learned helplessness, boredom, and attention seeking.

Anxiety and Frustration

Many compulsive behavior disorders appear to present under the influence of excessive frustrative arousal and stress (Hewson and Luescher, 1996). Anxiety, frustration, and other forms of stressful arousal have been frequently implicated in the development of CBDs. These adverse emotional antecedents are frequently the result of conflict situations. Disruptive conflict, sufficient to disrupt purposive behavior, predictably occurs under circumstances in which dogs are strongly and equally motivated to behave in mutually incompatible ways at the same time. Presumably, under the influence of disruptive conflict, susceptible dogs are caught up in a psychologically intolerable state in which they are compelled to act but are unable to do so in a decisive way—a situation that cannot be merely escaped or ignored. Under such circumstances, a remote substitute behavior, irrelevant to both horns of the conflict, may be emitted and repeated as long as the conflict continues without resolution. This general theory has considerable appeal and is frequently referred to in the literature; however, it should be emphasized that the origin of many common compulsive behaviors cannot be readily traced to an identifiable precipitating conflict. In addition to conflict, many other environmental conditions may cause receptive dogs to exhibit compulsive behavior. Although the conflict theory may not explain the development of all compulsive behaviors, compulsions and other maladaptive behaviors have been produced and studied under laboratory conditions by inducing insolvable conflict.

Since the time of Shenger-Krestovnikova's famous experiments inducing neurosis in dogs (Pavlov, 1928/1967), many related experimental animal models have been used to investigate the etiology of neurotic behavior (see *Learning and Behavioral Disturbances* in Volume 1, Chapter 9). Several of these studies have stressed the importance of insolvable conflict in the development of neurotic compulsions. For example, Maier (1961) succeeded in producing a rigid behavioral fixation or stereotypy in rats by exposing them to an insolvable discrimination task. The rats in his experiment were unable to solve the "rigged" discrimination successfully and soon refused to jump, since doing so resulted in their bumping into locked discrimination cards and falling into a safety net below. The decision not to jump, however, was not a permanent solution, since the experimenter soon prodded them into action with a blast of air.

The result was the development of a position stereotypy or fixation. The rats chose one side or the other and persistently jumped in that direction even after the discrimination task had been restored to a solvable form. Maier speculated that the persistence of these abnormal behavioral fixations paralleled neurotic compulsive habits in human subjects.

A central feature of Maier's method for inducing neurosis is the imposition of a high degree of tension caused by avoidance-avoidance conflict. Such conflict is generated by placing an animal in an impasse between two equally undesirable alternatives. Avoidance-avoidance conflict is commonly observed in punitive situations where a dog is unable to abstain from some behavior or unwilling to perform a required behavior, but, nonetheless, is imposed upon to abstain or perform by threat of punishment. If this conflict situation is accompanied by the presence of poorly differentiated discriminative stimuli, then one is presented with a very similar scenario to the one described by Maier.

Another common configuration of conflict involves the evocation and collision of incompatible unconditioned responses, usually in the form of simultaneous approach and withdrawal behavior. The result is an approach-avoidance conflict. This form of conflict was studied by Masserman in his experiments with cats. Cats that were previously trained to expect food on approach to a hopper were exposed to an startling blast of air or shock as they began to eat. The unexpected aversive stimulation triggered a disorganizing expectancy reversal, causing the cats to exhibit a persistent pattern of phobic and compulsive behavior.

Workers in Pavlov's laboratory used a similar method to induce neurotic symptoms (Pavlov, 1928/1967, 1941). First, dogs were conditioned to expect the presentation of food following a certain number of metronome beats. Once the conditioned response was well established, an aversive stimulus was arbitrarily presented instead of the expected food. The approach-avoidance conflict generated by this expectancy reversal resulted in disturbances that Pavlov called *focal neuroses* or displacement stereotypies. Another procedure used in Pavlov's laboratory involved simultaneously eliciting potent incompatible emotional reactions (e.g., presenting food to a hungry dog together with shock). This arrangement caused a violent collision of incompatible expectations, precipitating internal approach-avoidance conflict and associated neurotic symptoms. Pavlov believed that approach-avoidance conflict was etiologically relevant to the development of OCDs in humans (Astrup, 1965). The disturbing effects of conflict led Pavlov (1941) to imagine what dogs might say, if they were able, about the causes of their various "neurotic" disturbances:

> One can conceive in all likelihood that, if these dogs which became ill could look back and tell what they had experienced on that occasion, they would not add a single thing to that which one would conjecture about their condition. All would declare that on every one of the occasions mentioned they were put through a difficult test, a hard situation. Some would report that they felt frequently unable to refrain from doing that which was forbidden and then they felt punished for doing it in one way or another, while others would say that they were totally, or just passively, unable to do what they usually had to do. (84)

Pavlov's observations emphasize that some dogs, especially overly excitable or inhibited ones, may respond adversely to aversive compulsion. Overly excitable dogs are less able to control impulses without extreme exertion and strain, whereas overly inhibited dogs may be unable to respond effectively under the pressure of punitive compulsion. Pavlov's observations also underscore the importance of providing dogs with adequate instrumental control over punitive events. When punishment occurs in an unpredictable or uncontrollable manner (i.e., independently of what a dog does or does not do), it may exert excessive or, potentially, pathological demands upon a dog's ability to adjust.

Negative Cognitive Set

Although conflict and stress appear to represent significant necessary conditions for the expression of compulsive behavior, as already noted, conflict alone does not provide an adequate explanation for the appearance of

CBDs. Identical exposure to conflict and stress may cause some dogs to develop a compulsive behavior problem, while leaving other dogs unaffected. A dog's ability to respond adaptively (or not) to conflict and stress is determined by various biological factors, the overall quality and cumulative effects of previous learning, and the animal's general ability to cope under adverse conditions. All three factors affect the manner in which dogs respond to conflict and stress. Dogs susceptible to CBDs may be more prone to exhibit compulsive behavior because they are unable to perform efficiently under stressful pressure. The cause of this impairment may be traced to an acquired cognitive deficit (see *Learned Helplessness* in Volume 1, Chapter 9). Some dogs exhibiting compulsive behavior may be affected by a pervasive belief or *negative cognitive set,* such that whatever they choose to do will be equally ineffectual and irrelevant to what actually occurs as a result of their action. The influence of a such an inimical efficacy expectancy may intrude most disruptively in emotionally stressful situations where a choice must be made between two highly emotional and opposing alternatives. As the result of a history of excessively unpredictable and uncontrollable learning events, vulnerable dogs may be predisposed to respond to stressful situations in more arbitrary and rigid ways. Under the stress of conflict, such dogs may be affected by a global pessimism or *learned helplessness,* inclining them to expect that all possible responses available to them will be equally useless and ineffectual. When exposed to heightened stress and conflict, predisposed dogs (unable to act functionally and voluntarily) may be compelled to adopt compulsive behavior as a stress-reducing strategy.

Boredom

Another factor putatively implicated in the development of compulsive behavior in animals is boredom (see *Boredom* in Chapter 4). Except in extreme cases of social isolation or excessive confinement, appealing to boredom as a primary cause of compulsive behavior is difficult to defend. Many dogs are exposed daily to incalculable boredom, but few of them develop compulsive habits. Boredom is common, but compulsive disorders are relatively rare. Further, if boredom were a primary cause of compulsive behavior, one would expect that supplemental activities, exercise, and social contact should reverse or attenuate observed symptoms. Although environmental enhancements aimed at optimizing stimulation for dogs may be helpful, once compulsive habits have formed the provision of environmental enrichment alone is rarely sufficient to modify the behavior.

Attention Seeking

Compulsive habits may be reinforced by social attention (both negative and positive) obtained by a dog from either its owner or other persons with whom it comes into regular contact. Many whirlers and tail chasers can be prompted to perform the behavior by waving a finger around above their heads. While the stimulus itself may elicit an unconditioned whirling response in some dogs, such behavior may have been learned as a result of deliberate or inadvertent training. Some rather bizarre habits have been identified as operating under the influence of attention-seeking motivations. Hart (1980), for example, has reported an *attention-getting* motivation underlying a wide array of compulsive behaviors and psychosomatic conditions:

> Attention-getting behavior almost defies categorization. The behavior may appear as a major disorder such as lameness, paralysis of the rear legs, shadow chasing or hunting for imaginary objects. The behavior may involve autonomic response such as diarrhea, vomiting or asthmalike reactions. Mutilation of a leg or tail, or seizurelike disorders, may also be attention-getting. (99)

Unfortunately, the way attention-seeking behavior is usually interpreted involves considerable anthropomorphic contamination, and the concept needs a scientific definition. In general, the significance of attention seeking is probably related to active-submission behavior, rather than a calculated effort by the dog to obtain enhanced social contact and recognition. The presence of affection and fear underlying active-submission behavior together with social frustration provides a potential locus of significant conflict, perhaps

sufficient to support compulsive behavior (see *Adjunctive Generation of Hyperactivity,* below). Chronic conflict between the owner and dog involving affection and fear offers an alternative interpretation of attention-seeking behavior based on an adjunctive generator analysis—an approach that may be more useful than the usual social reinforcement theory. Active-submission behavior and associated excesses (e.g., jumping up, vocalizing, pawing, licking, and various other active-approach and contact excesses) are often the objects of considerable control efforts—efforts that aim to thwart or suppress their expression. Thwarting active-submission behaviors may simultaneously increase social conflict as well as introduce significant frustration, thereby possibly facilitating compulsive behavior in susceptible dogs.

The adjunctive conflict analysis offers an alternative way to understand how such diverse problems as those identified by Hart could operate under the influence of an *attention-getting* motivation. Figure 5.4 shows a Border collie that presented with a compulsion to retreat under a desk whenever the owner picked up the telephone. Once there, the dog shadow chases, barks, and snaps at nonexistent objects. Although clearly suggesting an attention-seeking etiology (the behavior occurs primarily in the presence of one family member), oddly the owner expressed concern about the dog's lack of affectionate display and closeness. In addition, the dog is highly reactive, fearful of novelty, and intolerant of unfamiliar social situations. Besides the aforementioned compulsions, the dog exhibits several other variants that regularly occur under the influence of a variety of social triggers. Apparently, such behavior is emitted in the presence of adverse or stressful circumstances as a coping or holding pattern. The Border collie's compulsive behavior is probably due to a genetic susceptibility, fostered and incubated under the influence of active-submission conflicts and persistent frustration resulting from its failure to achieve more satisfying social relations.

FIG. 5.4. This Border collie exhibits a variety of compulsive habits, especially lunging and snapping at shadows and at her reflections. Episodes are reliably elicited whenever the owner talks on the phone, at which time the dog runs under a desk and yelps, whines, barks, and lunges at shadows.

COMPULSIVE BEHAVIOR PROBLEMS

Licking, Sucking, and Kneading

A common compulsive habit observed in dogs is sucking and kneading of blankets. This behavior is highly correlated with removing a puppy from the mother too early in its development. In many cases, the sucking-and-kneading compulsion does not appear until after puppies reach puberty, sometimes not until after 1 year of age. Dogs exhibiting this habit rhythmically suck and knead on a blanket as though quietly nursing on it. Owners note that it most often occurs when dogs appear slightly stressed by environmental events or are bored. In most cases, the habit is not self-injurious and is left untreated, partly because it gives such dogs so much apparent pleasure. The habit is best controlled through prevention. Puppies taken from the mother prior to normal weaning times should be fed by a method as similar to natural nursing activity as possible. Levy (1941) suggests that the sucking compulsion may be driven by frustration. He carried out an experiment in which puppies were given adequate milk to satisfy their nutritional needs but not enough time feeding to satisfy their sucking needs.

The control puppies, on the other hand, were given adequate milk to satisfy their hunger, as well as time to satisfy their sucking needs. In contrast to the satisfied group, the frustrated puppies exhibited increased sucking activity directed at nonnutritive objects (e.g., other puppies, their paws, and a variety of objects). In addition, as they matured, frustrated puppies engaged in excessive licking of their food plates.

Other compulsive oral habits commonly exhibited by dogs involve excessive licking directed toward the body, people, floor, or furniture. When dogs direct licking toward their extremities (usually the carpus or tarsus), this may cause physical effects ranging from minor alopecia (hair loss) and hyperplasia (thickening of the skin) to lick granulomas (Figure 5.5). Such problems usually involve both medical and behavioral causes and should be treated jointly by a veterinarian and a behavior counselor. Excessive self-directed licking is especially common among large breeds (e.g., Labrador retrievers, golden retrievers, and Doberman pinschers). Licking directed toward furniture or flooring is usually less problematic, but occasionally dogs lick so much that they inflict minor abrasions and injuries to the lower jaw or lips.

FIG. 5.5. This German shepherd exhibits a classic carpal granuloma resulting from compulsive licking.

Petra Mertens (1999) describes an unusual case involving a male 4-year-old miniature bullterrier. The dog, which the female owner characterized as being very oral and excessively interested in food, had developed a persistent habit of licking the arms and legs of her quadriplegic husband. One afternoon, the owner left the dog alone with her husband to find upon returning that the dog had erstwhile chewed off her husband's first toe and removed half of the second one. This rare example of allomutilation (from the Greek *allos* or "other") appears causally related to the dog's persistent tendency to lick the husband's skin, gradually resulting in gnawing, and, finding no inhibitory feedback limiting the extent of the oral behavior and its damage, resulted in the loss of the man's toes. This event underscores the importance of exercising caution when exposing persons who lack nociceptive sensitivity in their extremities to dogs with heightened oral interests. Dogs exposed to such individuals should be carefully supervised and receive inhibitory training to limit excessive licking behavior.

A key consideration in the treatment of compulsive behavior problems is the identification of social and environmental sources of stress and conflict. Excessive self-licking has been associated with socially conflicted situations, such as the introduction of a new animal (or person) into the household or separation-related distress. For some dogs, grooming and licking may be a way to cope with anxiety. Some compulsive licking habits appear to be under the influence of an attention- or comfort-seeking motivation. In such cases, licking may have been initially triggered by an actual traumatic event or injury, but, as the result of owner attention giving and comforting while licking, the licking behavior may have subsequently become a means to obtain attention from the owner. Finally, excessive crate confinement or neglect has been implicated in the development of grooming and licking excesses. For example, Hetts and colleagues found that isolated dogs tend to engage in more "bizzare

movements" and distress vocalizations, and when confined to small cages they tend to exhibit more grooming activities (e.g., scratching, licking, and biting the skin). Finally, excessive licking is often associated with etiological factors other than psychogenic ones, including allergies, previous trauma, foreign bodies, infection, and arthritis (Veith, 1986). Such self-injurious licking habits often respond to medical treatment alone. Severe and refractory cases are sometimes treated with radiation therapy (Rivers et al., 1993). Once well established, ALD is rarely completely curable but is manageable through a variety of veterinary and behavioral interventions. In cases where psychogenic factors are also suspected to play a contributory role, systematic behavioral efforts should be introduced to prevent symptoms from reoccurring.

Locomotor Behavior

Many examples of locomotor compulsive behavior have been already discussed. The most common movement compulsions and stereotypies involve repetitive pacing, running fence lines, and other locomotor excesses. Under close confinement, dogs may develop persistent whirling habits. Other dogs may spend large amounts of time and energy unproductively pacing or charging up and down fence lines in a stereotypic manner or exhibit compulsions such as leaping up and down. Obviously, such dogs are motivated to move beyond the fence by the attraction of some external stimulation or desire to roam. The fence represents a conflict-laden barrier between what a dog would prefer to do and what it is constrained to do as the result of the surrounding fence, underscoring the role of frustration in the development of such problems. A compulsive factor appears to affect territorial aggression and fighting behavior occurring along fence lines (see *Variables Influencing Territorial Aggression* in Chapter 7). Similar conflict-generating conditions occur when dogs are restrained on leash. In this latter case, the dog is attracted by various impinging stimuli but prevented from acting on its impulses by the confinement of the leash. The result is compulsive investigatory and pulling behavior in spite of the discomfort produced by the owner's frustrated yanking back. Dogs chained outdoors may develop compulsive digging or chewing habits, providing a substitute outlet for the frustration caused by such restraint. R. C. Hubrecht and colleagues (1992) found that dogs housed in small pens tend to develop stereotypic circling habits, behavior that is probably expressed as pacing when dogs are housed in larger pens. Finally, some forms of hyperactivity may be attributable to a compulsive etiology (see below).

Sympathy Lameness: Deceit or Compulsion?

When exposed to increased anxious arousal, dogs that have suffered injury to a limb or foot may display a pattern of limping or paw raising in the absence of actual injury or pain (Fox, 1962). The result is a compulsive reliance on the display of lameness in order to obtain *reward-sympathy* from the owner whenever the dog becomes distressed or anxious. Under conditions of emotional conflict, dogs may draw attention to themselves and gain relief by exhibiting *sympathy lameness.* To my knowledge, the first recorded case of sympathy lameness was reported by George Romanes (1888) in his interesting book *Animal Intelligence.* Romanes recounts the observations of a correspondent who had written to him about a peculiar behavior that gave credence (in his opinion) to the possibility that dogs can exhibit deceitfulness:

> He [a King Charles spaniel] showed the same deliberated design of deceiving on other occasions. Having hurt his foot he became lame for a time, during which he received more pity and attention than usual. For months after he had recovered, whenever he was harshly spoken to, he commenced hobbling about the room as if lame and suffering pain from his foot. He only gave up the practice when he gradually perceived that it was unsuccessful. (444)

Lorenz (1955) describes a similar case that he labeled a behavioral "swindle" (suggesting a similar interpretation to the one proposed by Romanes) involving feigned lameness exhibited by one of his dogs. The dog in question had suffered a severe strain with tendonitis

that, consequently, required special attention and extended care. The dog recovered but apparently learned that limping produced sympathetic treatment from her owner. She subsequently developed a selective lameness whenever it was in her interest to do so:

> If I cycled from my quarters to the military hospital, where she might have to remain on guard by my bicycle for hours on end, she limped so pitifully that people in the road often reproached me. But if we took the direction of the army riding school, where a cross-country ride was likely to ensue, the pain had gone. The swindle was most transparent on Saturdays. In the morning, on the way to duty, the poor dog was so lame that she could scarcely hobble behind the bicycle, but in the afternoon, when we covered the thirteen miles to the Ketcher See at a good speed, she did not run behind the bicycle but raced ahead of it at a gallop, along the paths which she knew so well. And on Monday she limped again. (181)

From the foregoing anecdotes, it would appear that sympathy lameness is acquired as the result of increased attention given to a dog following a limb injury, with the dog learning to feign discomfort to get attention and affection from its owner (Hart and Hart, 1985), but another possible interpretation is that such behavior may stem from active-submission behavior and conflict (see above), resulting from increased petting and contact between the owner and dog following the injury. Whatever the case, sympathy lameness is a rather uncommon phenomenon, and before attributing an attention-seeking causation to the behavior, it should receive a careful veterinary evaluation. Differential diagnosis should exclude other more common and likely physical causes underlying signs of lameness. Limping should always be interpreted first in terms of a potential physical ailment and, only after such efforts fail to turn up a cause, should the possibility of sympathy lameness be seriously considered. If it is clear that the signs of lameness appear only under emotionally stressful situations, then *maybe* sympathy lameness is occurring rather than a strain, growth pains, or some other physical causation (e.g., Lyme disease).

Assessment and Evaluation

The first step in evaluating dogs with compulsive habits is to obtain relevant information, including a medical history. It is crucial for the consulting trainer to get a detailed picture of the dog's behavior, along with a thorough inventory of the various eliciting stimuli and contexts in which the behavior has occurred in the past, prevailing motivational conditions under which the behavior tends to occur, and the approximate frequency and duration of the behavior's occurrence. Additionally, the owner should be questioned with regard to previous methods used to control the dog's behavior, including both successful and unsuccessful ones. In severe cases involving acute onset, automutilation (self-injury), or seizure activity, the client should be referred to a veterinarian for a medical evaluation.

In many cases, finding a correlation between a compulsive behavior and a specific precipitating stimulus or environmental condition is not possible. In such dogs, a compulsive habit may be under the stimulus control of an internal cue and emitted to modulate a generalized state of frustration or anxious arousal. When such causes are suspected, steps should be taken to reduce adverse emotional arousal. Quality-of-life enhancements that often prove beneficial in reducing stress include increased daily exercise, play and training activities, and daily massage. In cases where a hunger tension is implicated, a dog's feeding can be adjusted by either increasing food intake or increasing the frequency of feedings. Some dogs are benefited by an ad libitum feeding schedule in which they are permitted to eat whenever they wish. Of course, not all dogs can be fed ad libitum without gaining weight, but many dogs can be fed in such a way without experiencing much, if any, significant weight gain. In those dogs where ad libitum feeding is inappropriate, the frequency of measured feedings can be increased during the day.

Compulsive behavior often occurs under the influence of excessive anxiety or frustration elicited by some external stimulus or situation. The most effective training method for managing CBDs involves a combination of graduated exposure, counterconditioning,

and response-prevention procedures. For example, when the CBD is either precipitated or augmented by the presence of the owner or some other specific stimulus, it is often useful to gradually expose the dog to the eliciting stimulus while at the same time blocking the repetitive activity or by eliciting incompatible emotional responding (e.g., relaxation or appetence). In the case of intractable or refractory compulsions involving self-injury (e.g., ALD), aversive counterconditioning and punishment procedures may be effective (Eckstein and Hart, 1996). (Specific treatment recommendations for the control and management of CBDs is deferred for discussion in a forthcoming volume.)

Prevention

The etiology of compulsive behavior is only partially understood. Many dogs exhibiting locomotor compulsions exhibit general hyperactivity and impulse-control problems. Dogs with licking compulsions often exhibit anxious attachments toward their owners, may have suffered the loss of a significant other (animal or human), may be stressed by social competition or rivalry (perhaps involving the introduction of a new pet or baby), or may have undergone long-term neglect and social deprivation.

Compulsive behavior is commonly seen in dogs that exhibit signs of chronic stress, excitability, and insecurity. Such dogs can be provided with a sense of security and well-being by establishing strong leadership and making significant events predictable and controllable. Owners of such dogs should not neglect to establish definite boundaries and enforce them when necessary but should be careful to avoid highly charged emotional interaction triggering chronic fright-flight-fight conflicts. Other sensible precautions and suggestions include

1. Provide the dog with choices during stressful and conflict dense situations.
2. Interact with the dog in predictable, consistent ways, giving the dog a degree of control over what happens to it.
3. When discipline needs to be administered, make certain that appropriate alternative behaviors are prompted and reinforced.
4. Establish a daily regimen of obedience training based on positive reinforcement and play.
5. During training activities, emphasize clear communication and mutual understanding—not simply exercising one-sided control and dominance.
6. Make the dog feel secure in its social relationships by providing adequate daily affection and attention.

Finally, a dog's confidence is enhanced by providing it with structured training and socialization activities from an early age. Such treatment facilitates the development of behavioral optimism, causing the dog to believe that success is always possible, thus effectively immunizing it against acquired learning disabilities (negative cognitive set) and related compulsive habits.

PART 2: HYPERACTIVITY

Hyperactivity versus Hyperkinesis

Excessively active dogs presenting with signs of impulse-control problems and other relevant symptoms (e.g., attention deficits, inability to calm down, persistent reactivity to restraint and confinement, aggressiveness, impaired learning abilities, and insensitivity to punishment) should be evaluated for hyperactivity and possible hyperkinesis syndrome. Dogs exhibiting hyperactivity (especially in those cases presenting with emotional instability, impulsivity, and aggressiveness) may be candidates for treatment with a central nervous system (CNS) stimulant (e.g., methylphenidate) and should be referred for a veterinary evaluation. Increased excitability and hyperactivity may be associated with various disease conditions (e.g., hyperthyroidism) that should be considered as part of a differential diagnosis performed by a veterinarian. In the discussion that follows, I have opted to use the term *hyperactivity* to designate the common form of excessive activity and attention deficits that occur in dogs without physiological concomitants. The term *hyperkinesis* is here reserved for those cases of hyperactivity and attention-impulse deficits that respond to stimulant medication.

SIGNS AND INCIDENCE

Impulse Control and Attention Deficits

Hyperactivity and attention deficits are frequently exhibited by puppies and adolescent dogs presented for behavioral training. These problems are widely distributed among dog breeds but are especially prevalent among hunting and working breeds—dogs selectively bred for enhanced environmental alertness, vigilance, and high activity levels. Affected dogs frequently exhibit an abnormally short attention span and impulsiveness. This attention impairment makes them unable to concentrate on any one thing or task for long before being distracted by something else. Some dogs appear as though everything encountered by them, no matter how trifling or insignificant, is treated with an equally active and fleeting interest. Hyperactive dogs are especially sensitive and reactive to novelty or the presence of unfamiliar persons or animals, often displaying a pronounced inability to habituate to such stimulation. Such dogs appear to be strongly influenced by a diffuse incentive or seeking mechanism that is activated by novelty, with resulting hyperarousal, exploratory and olfactory activity, and exploration-related problems (e.g., destructiveness). Consequently, such dogs may exhibit persistent restlessness and disorganized activity in search of rewarding stimulation. Frustrated owners often complain that their dog "can't sit still" or that it "gets into everything."

Reward, Inhibition, and Delay of Gratification

Another important behavioral manifestation exhibited by hyperactive dogs is their resistance to inhibitory training and physical control. Hyperactive dogs appear to be much less sensitive to aversive stimulation and punishment than are average dogs. Further, they often become even more excitable and unmanageable when efforts are made to constrain them forcefully. On the other hand, they are often very responsive to reward training, but rewards, if they are to work, must be given on a near-continuous basis in order to secure their wavering and easily distracted attention (Sagvolden et al., 1993). If reinforcement is scheduled intermittently or made contingent on the performance of a chain of intervening responses, hyperactive dogs may rapidly lose interest. The impulsive character of hyperactivity is reflected in the affected dog's inability to wait or to delay gratification. Although hyperactive dogs may attend and work well under conditions of continuous reinforcement, they exhibit clear deficits when it comes to situations requiring a long delay before reinforcement is delivered (e.g., a long sit-stay). This pattern is also evident among children with attention-deficit hyperactivity disorder (ADHD) who are easily distracted from deferred goals by the offer of more immediate but smaller rewards. To investigate the role of delay of reinforcement Sagvolden and colleagues (1992) performed a series of experiments with hyperactive rats. They confirmed the rat's preference for short-term reinforcers and the existence of deficits involving delay of reinforcement when compared to normal controls. In addition, they observed that CNS stimulants improved the effectiveness of delayed reinforcers for controlling repetitive operant tasks while simultaneously reducing the distractive strength of immediate reinforcers. These findings are consistent with the observed positive effects of CNS stimulants on impulse control and delay of gratification behavior in both hyperactive children and dogs.

Besides exhibiting a high degree of distractibility, impulsiveness, and various learning deficits, hyperactive dogs are impulsive and often emotionally unstable, possessing a low tolerance for frustration and sometimes exhibiting uncontrollable ragelike aggressive behavior. Parallel symptoms in child psychopathology have been identified and described (Hinshaw, 1994; Werry, 1994).

A biological factor certainly plays some role in the etiology of hyperactivity, but many social and environmental factors also contribute to its expression. Family dogs are especially vulnerable and prone to develop hyperactive behavior as the result of exposure to overly active and playful children. Additionally, hyperactive *play* may develop as an inadvertent result of ineffectual punishment. Although an owner may be quite sincere, the action taken is often attenuated as the result

of affection for the dog or personal inhibitions about such interaction. A dog may misinterpret this self-restraint and *kindness* as an awkward human invitation to play rather than punishment. Active dogs play hard and, while playing, frequently exhibit subdued agonistic challenges and threats that may be ethologically analogous to the owner's ineffectual punitive efforts. Such play is often so intense that it may be confused with real aggression (Voith, 1980a,b).

Etiology

Social and Sensory Deprivation

Waller and Fuller (1961) found that puppies reared under conditions of semi-isolation exhibited excessive compensatory efforts to initiate social contact when permitted to do so. When the puppies were kept with littermates continuously, the number of social contacts was reduced by 75%. These observations suggest that dogs may possess a biological *need* for some relatively fixed amount of daily sensory stimulation, motor activity, and social contact. If these requirements are not met, then various compensatory and excessive efforts may be emitted by dogs to secure them. Clearly, there exists a great deal of individual variability from dog to dog with respect to their specific needs. Just as hypothalamic set points control many basic biological drives like hunger and thirst, it is reasonable to hypothesize that general arousal and activity may be controlled by a similar subcortical homeostatic mechanism (Fox, 1974). According to this theory, dogs are motivationally and behaviorally activated to secure stasis through compensatory and excessive behavior when environmental conditions prevent them from obtaining optimal stimulation or vital resources needed to sustain them.

Hyperactive dogs are often exposed to routine isolation due to their behavioral excesses. This points to another set of contributing factors underlying hyperactivity: inadequate social attention, insufficient or irregular exercise, and excessive confinement. Active dogs subjected to daily crate confinement tend to become increasingly hyperactive and solicitous of attention. When released from confinement, the demands made by such dogs are anything but welcome by family members, who may have all but entirely rejected them as a result of their behavioral excesses. The situation is a vicious circle, with excessive behavior resulting in further rejection and isolation, thereby generating more attention-seeking behavior and hyperactivity. Also, excessive or noncontingent (uncontrollable punishment) may contribute to the development of hyperactive attention-deficit symptoms. A result of such treatment is diffuse vigilance and disorganized responding, especially after startling stimulation or at times associated with a history of unpredictable and uncontrollable punishment.

Adjunctive Generation of Hyperactivity

Attention-seeking and active-submission behavior appear to play a significant role in both hyperactivity and compulsive behavior, perhaps stemming from strong adjunctive-generator influences localizing in affection-fear conflict. As previously discussed, Falk suggests that excessive behavior is likely to result under the influence of conflict-laden *marginal* intermittent reinforcement (see *Schedule-induced Excessive Behavior,* above). It should be noted that both rich and lean schedules of reinforcement are relatively immune to conflict and the adjunctive generation of excessive behavior. In the case of rich reinforcement schedules, conflict is avoided, since consummatory behavior is ascendant, whereas, in the case of lean schedules, conflict is avoided because escape behavior dominates, causing the animal withdraw from the situation. Under the influence of *marginal* intermittent reinforcement, a *conflict* may localize between a consummatory vector and an escape vector of equal strength. Compulsive habits or hyperactivity may result in cases in which marginal intermittent reinforcement occurs chronically. Attention-seeking behavior, for example, may succeed often enough to maintain a dog's effort but not enough to offset an opposing motivational vector to give up trying (escape)—an unlikely outcome, in any case, for a highly dependent and sociable dog.

Active-submission behavior (i.e., attention seeking) may itself become a compulsive activity in its own right. A conflict between

affection and fear is embedded in submission behavior; that is, submissive dogs are simultaneously attracted to and repelled by the object of submission. *Affection keeps a dog in close contact with its owner, preventing the dog from resolving the conflict by running away, but fear prevents the dog from relaxing and fully enjoying the contact. As a result, contact comfort and reassurance may not satisfy a submissive dog, at least, not as long as it is engaged in active submission.* These observations may help to explain why some attention-seeking dogs are so insatiable, never seeming to get enough affection or contact comfort:

> Attention-getting behavior is found in the typical household situation in which the dog is already heavily indulged with love and petting. While it may seem illogical, dogs that are getting the most attention are those that will go to some effort to gain even more. It is probably impossible to satiate a dog with too much attention. Dogs that receive little attention from their owners have the least probability of acquiring this behavioral problem. (Hart and Hart, 1985:85)

Such dogs may engage in persistent licking, pawing, and other proximity-enhancing active-submission behaviors. This situation is very different from other drives, like thirst or hunger, that can be easily quieted by the consumption of food or water. For compulsive attention seekers, the consumption of social contact tends to generate more preparatory arousal (affection-fear conflict), resulting in more attention seeking but failing to quiet the escalating need for comfort and reassurance. Because of its motivational character, compulsive submission behavior is capable of generating high levels of anxiety. Because such dogs are often unsuccessful in their general social efforts, anxiety is joined by frustration to coactively increase activity levels and generate maladaptive and excessive behavior.

As a result, attention-seeking dogs may engage in a variety of adjunctive behaviors, such as destructiveness and hyperactivity. Treating such cases involves either (1) modifying generator conditions (alter the schedule of attention giving) or (2) directing the destructive or hyperactive behavior into more appropriate outlets. Although attention-seeking behavior may occur in close association with a variety of behavior problems, such behavior is probably not emitted as a means to obtain attention per se but as the adjunctive expression of marginal social reinforcement.

Neural and Physiological Substrates

During various classical conditioning studies involving the induction of stress by means of unavoidable aversive stimulation (shock), Corson and coworkers (1973) found that a small percentage of dogs were unable to relax while restrained in an experimental harness. Some of the dogs became so aroused and reactive that they attacked the harness and nearby equipment. These highly reactive dogs exhibited no signs of improvement over several training sessions. Hypothesizing that the symptoms were similar to those exhibited by hyperactive children, the researchers experimented with various CNS stimulants used to control hyperactivity in children. Children affected with ADHD respond *paradoxically* to CNS stimulants. Instead of causing them to become more active and excitable, as one might expect, the stimulants often cause them to become more calm and focused. They found that hyperkinetic dogs responded to amphetamines in a similar way, becoming less active, more focused, and even more affectionate.

Subsequent studies have confirmed many of Corson's original findings. Bareggi and coworkers (1979) have speculated that D-amphetamine enhances the activity of the neurotransmitters dopamine (DA) and norepinephrine (NE). At low doses, dopaminergic systems are activated whereas, at higher doses, both dopaminergic and noradrenergic systems are stimulated. Since high levels of amphetamine are required to generate the paradoxical effect, they reason that both catecholamine systems are probably involved. Recent studies with hyperactive rats and mice show that the differential response of animals to CSN stimulants is present in rodents. As a result, several new animal models of ADHD have been proposed. These models range from hyperactivity exhibited by "spontaneously hypertensive rats" to hyperactivity induced via chemical lesions of the rat brain. In one of these studies hyperactivity in rats was induced by destroying dopamine fibers with neurotoxins

(Kostrzewa et al., 1994). The lesioned rats responded in the typical manner to amphetamine treatment, thereby raising questions about the role of dopamine in the mediation of the paradoxical effects of CNS stimulants. These findings led the researchers to conclude that, in addition to dopaminergic activity, a serotonergic system is also involved:

> DA and 5-HT neurotransmission may mutually modulate spontaneous locomotor activity in rats and inhibit hyperactivity in humans. Either impaired ontogeny or injury of DA fibers, coupled with subsequent impaired ontogeny or injury of 5-HT fibers, may constitute the underlying basis of hyperactivity in ADHD. The effectiveness of amphetamine in controlling hyperactivity in ADHD is similarly thought to be due to the release of 5-HT, either directly or via action of released DA at 5-HT neurons. The implication is that 5-HT agonists, probably of the 5-HT_{2C} class, could prove to useful in treating ADHD. Likewise, if amphetamine is not acting directly on 5-HT neurons, but via DA release, then direct-acting DA agonists could also become useful in treating ADHD. (165–166)

These findings support the *minimal brain dysfunction* theory of ADHD. Important neuroimaging studies of the frontal lobes and basal ganglia also suggest the possibility of an organic etiology underlying hyperkinesis and ADHD.

More recently, ADHD research has explored the possible role of defects in the DA reuptake mechanism, particularly involving DA-transporter molecules located on the plasma membrane of DA neurons. DA transporters mediate the reuptake and conservation of extracellular DA by absorbing and concentrating it within the cytoplasm for later use. Disturbances of transporter activity may cause a higher-than-normal concentration of DA to remain in extracellular fluids, thereby causing increased motor activity, stereotypies, impulsivity, and cognitive deficits. Research with *knockout* (KO) mice (mutants lacking the specific gene responsible for encoding the DA transporter) have revealed a number of interesting findings with respect to the differential roles of DA, hydroxytryptamine (5-HT or serotonin), and NE systems in the expression of hyperkinetic symptoms (Gainetdinov et al., 1999). KO mice have five times as much DA concentrated in extracellular fluids than do normal mice. As a result, KO mice exhibit significantly higher levels of motor activity and show profoundly impaired cognitive abilities. Psychostimulants (e.g., dextroamphetamine and methylphenidate) were found to exert a significant attenuation of hyperkinetic symptoms in KO mice—effects that cannot be attributed to changes in DA-transporter activity. In addition to the aforementioned stimulant medications, the selective 5-HT reuptake inhibitor fluoxetine was found to attenuate hyperactivity significantly in KO mice but had no discernible effect on normal mice. Finally, the investigators selectively activated and inhibited NE transporters, thereby demonstrating that NE plays no significant role in the expression of hyperkinetic symptoms. In addition to the attenuating effects of fluoxetine, they found that treatment with 5-HT precursors [L-tryptophan and 5-hydroxytryptophan (5-HTP)] significantly reduced motor activity and stereotypic behavior in KO mice. Gainetdinov and colleagues conclude that the stimulants commonly used to treat ADHD probably produce therapeutic effects on downstream serotonin transporters rather than directly affecting DA receptors or transporters.

Kenneth Blum and colleagues (1997) at the University of Texas (San Antonio) have reported compelling evidence suggesting that ADHD, as well as a variety of other common impulse problems and conduct disorders (including aggressive behavior), may develop from an inability to obtain sufficient reward by engaging in everyday activities. This condition, referred to as *reward deficiency syndrome* (RDS), is believed to be a genetic aberration affecting dopamine reward pathways, in particular dopamine D2 receptors. In cooperation with several other neurotransmitters [e.g., serotonin, opioids, and γ-aminobutyric acid (GABA)], dopamine plays a central role in the mediation of reward and the experience of well-being. Blum's research group identified a gene variant (A1 allele) that appears to constrain the expression of D2 receptors on the dopamine neuron by 30%. They found that individuals possessing the A1 allele (especially those who are homozygous for it) are at a significantly greater risk of developing a variety

of problem behaviors and appetites [see Singh et al. (1994)], including self-medication (addictions and excessive eating) and dysfunctional behavioral strategies (impulsive and compulsive tendencies), all apparently aimed at achieving improved reward satisfaction.

In the case of dogs, it might be likewise expected that failure to experience reward or well-being as the result of everyday social contact and activity may stimulate affected individuals to engage in impulsive-compulsive behavior and inappropriate appetitive gratification, such as increased attention seeking and pica. The inability of such dogs to achieve internal reward or satisfaction may prompt them to engage in excessive behavior (hyperactivity) seeking sufficient reward. Such a dysfunctional reward mechanism may help to explain why efforts to satisfy affected dogs with attention, exercise, and affection (or food) do not appear to reduce substantially their apparent need for such things. Dogs suffering from RDS may fail to experience social contact as a reward in a consummatory sense, but instead experience it as an incentive or prod to seek more attention or activity. Such dogs may never gain true satisfaction from social interaction because the neural substrates mediating the social reward cascade are not functioning at an optimal level. This is consistent with the observations of Sagvolden and coworkers (1993), who found that hyperactivity was reduced in genetically hyperkinetic rats when they received more frequent reinforcement.

The putative influences exerted by genes regulating the dopamine transporter system on ADHD as reported by Gainetdinov and coworkers seem to conflict with the receptor diminishment hypothesis of Blum and colleagues, suggesting that more research is necessary to uncover the neurobiological substrates controlling the expression of hyperkinesis and related impulsive and compulsive tendencies in dogs. Clearly, though, the dopamine limbic circuits appear to play a significant role in the development of excessive behavior. Interestingly, in this regard, Niimi and associates (1999) at Gifu University, Japan, have reported significant differences in genetic variants controlling the expression of dopamine D4 receptors in golden retrievers and Shibas. The D4 receptor is believed to be involved in *novelty seeking* and other behavioral tendencies depending on the allele (short or long) expressed (Ebstein et al., 1996). In humans, the long allele is not only associated with novelty seeking, but also various personality dimensions, such as compulsiveness, excitability, quick temper, and fickleness, whereas the shorter allele is most often associated with reduced novelty seeking and an opposite set of personality characteristics (e.g., reflective, slow to anger, stoicism). Niimi's group found that the golden retriever was most likely to possess the short A allele (78.9%), whereas the long D allele was most common in the Shiba (46.7%). The D4 receptor is primarily found in the limbic system and expressed in neurons exerting direct effects upon cognition and emotional behavior. These findings support the view that the limbic dopamine system plays an instrumental role in the expression of canine behavioral traits.

Although the neural sites and pathways involved in the expression of hyperactivity (ADHD) are not definitively known, various neuroimaging studies suggest that the caudate nucleus and the striatum (basal ganglia) are involved to some extent (Hynd and Hooper, 1992). Both of these sites project to frontal lobe areas involved in the regulation of locomotor activity and impulse control. Studies with children exhibiting ADHD indicate that both the caudate nucleus and the striatum show low metabolic activity and blood flow—a condition that is ameliorated by the administration of methylphenidate and reversed as the drug wears off. Another distinguishing neuroanatomic feature of childhood ADHD is the finding that affected children do not exhibit the typical frontal lobe asymmetry (right > left) of normal children but instead tend to exhibit symmetrical (right = left) frontal lobe widths. Further, it has been found that hyperactive children have significantly narrower right frontal lobe widths than children not exhibiting ADHD (Hynd and Hooper, 1992).

Relevant studies were performed by Sechzer (1977) on split-brain kittens. The split-brain preparation involves surgically severing the corpus callosum (a large structure of interconnecting fibers communicating between the right and left hemispheres) and

the striatal pathways connecting the right and left caudate nuclei. Split-brain kittens exhibited a constant, poorly focused hyperactivity not seen in normal kittens. At 6 months of age, kittens were injected with D-amphetamine and observed for behavioral changes. Striking reductions in general activity levels and distractibility were immediately seen, but hyperactive symptoms returned within 2 hours after the injection. At 1 year of age, normal and split-brain cats were compared in terms of their respective abilities to learn a simple discrimination task. As observed in hyperkinetic dogs, split-brain cats only very slowly habituated to the training environment, made frequent attempts to escape, and exhibited a high degree of distraction toward external noises. The results of discrimination training showed that split-brain cats were consistently slower than normal cats at learning the task. However, when split-brain cats were medicated with D-amphetamine, they learned the task slightly more rapidly than normal counterparts.

CNS-stimulant-response Test

Some authors have recommended a stringent diagnostic procedure for determining a dog's candidacy for stimulant therapy. The stimulant-response test is administered by challenging the dog with a dose of D-amphetamine and observing various physiological parameters (Luescher, 1993a). The dog's general activity level, demeanor, and various physiological parameters are observed. Hyperkinetic dogs respond to CNS stimulants paradoxically; that is, they calm down and become more focused. The stimulant-response test is performed by taking a baseline measurement of a dog's activity level, reaction to restraint (holding the dog in sit or down position), heart rate, and respiration rate, and (more rarely) salivary and urinary output are measured. Following an oral dosage of D-amphetamine, hyperkinetic dogs will tend to calm down, accept restraint more readily, and exhibit a generalized decrease in the aforementioned physiological measures (Voith, 1979). These effects usually take place within 2 hours—sometimes within 30 minutes after dosing a dog. Dogs that do not respond may require a higher challenge dose. Voith (1980c) describes a method whereby the dose is increased by small amounts every 24 hours until the dog either becomes more active or begins to calm down. Dogs that respond by becoming more active and uncontrollable are not candidates for stimulant therapy. Although a real diagnostic entity, and perhaps underdiagnosed, true hyperkinetic syndrome probably does not occur at the frequency suggested by Campbell (1973, 1992), who claims that 75% of "hyperreactive" dogs given the stimulant-response test show positive results.

A study with hyperactive rats selected from a natural population offers an additional diagnostic dimension for evaluating hyperkinesis with attention deficits. Kohlert and Bloch (1993) observed that rats (not specifically bred for hyperactivity) frequently exhibited signs of hyperactivity similar to those presenting with ADHD. They found that a subpopulation of hyperkinetic rats can be easily isolated through a simple screening process involving three criteria: (1) presence of hyperactivity, (2) positive attenuation of activity levels in response to amphetamine, and (3) decreased ability to attend selectively to relevant stimuli during avoidance training. The study included an interesting test procedure for quantifying a subject's relative ability to attend selectively, that is, to pay attention to relevant cues while ignoring irrelevant ones. Disturbances of selective attention are frequently implicated in the diagnosis of hyperkinesis, but, unfortunately, objective criteria for its assessment have not been devised for dogs.

Dietary Factors and Hyperactivity

Several studies have investigated the possible role of food additives and colorants in the development of ADHD in children. Most of this research has been unable to find a convincing causative link between ADHD and the various agents studied (Weiss, 1991). Likewise, among dogs, no scientific evidence exists to date supporting the popular belief that additives and colorants cause hyperactivity and other behavior problems. A study performed by Barcus and coworkers (1980) failed to show a causal linkage between FD&C red

dye 40 or butylated hydroxyanisole (BHA)—substances suspected (but not proven) to play a role in the etiology of childhood ADHD—and hyperkinesis in Telomian hybrid dogs. Although the study failed show a direct linkage between red dye 40 and BHA in the development of hyperactivity, it should be noted that during a 28-day additive-free transition period all dogs exhibited a sharp decrease in hyperactive symptoms. Recent studies involving children have also discounted the role of excessive amounts of sugar and development of hyperactivity (Hynd and Hooper, 1992). However, studies with rats suggest that increased levels of dietary carbohydrates (including sugar) relative to decreasing protein intake results in the expression of higher activity levels (Spring, 1986).

Another potential source of hyperactivity in dogs is chronic lead poisoning. Two common sources of such poisoning are destructive chewing on linoleum or surfaces painted with lead-based paints. Silbergeld and Goldberg (1974) induced hyperkinetic symptoms in mice by exposing them to lead. The hyperkinetic symptoms were palliated with high doses of D-amphetamine. A large study performed by Thomson and colleagues (1989) found a positive correlation between lead blood levels and aggressive-hyperactive tendencies in children. Puppies exposed to lead should be tested and appropriately treated.

Inadequate nutrition may permanently affect general activity levels, especially when deprivation occurs early in life. Michaelson and coworkers (1977) found that hyperkinetic symptoms could be induced by manipulating dietary intake during a critical period for brain growth in mice. Mice were divided into two groups: group-I mice were raised in large litters in which 16 young were placed with a single mother (starved). Group-II mice were raised in small litters of 8 animals per nursing mother (controls). At 35 days of age, the two groups of mice were compared with regard to general activity levels and their response to D-amphetamine. Following a brief period of adaptation, starved rats exhibited a higher level of activity when compared with well-nourished controls. Upon administration of D-amphetamine, the starved rats became less active than the controls, a trajectory of decreasing activity that continued to develop into the following hour after medication. Growth-retarded mice exhibited a strong paradoxical effect to D-amphetamine. These observations emphasize the importance of good nutrition during early growth periods in puppies. Breeders should be especially careful in their management of puppies belonging to large litters or those being nursed by a mother unable to produce sufficient nutrition through lactation alone. Further, the mother's dietary intake should be carefully evaluated and adjusted to meet the demands of nursing her litter.

TWO CASE HISTORIES

Jackson

A collateral discovery made by Corson and colleagues (1973) was the pronounced effectiveness of D-amphetamine for the control of aggressive behavior. A cocker spaniel-beagle mix named Jackson, described as being "incurably" vicious toward other dogs and people, responded dramatically to medication with D-amphetamine. Tranquilizers like chlorpromazine and meprobamate did not reduce the dog's aggressive behavior; however, an oral dose of D-amphetamine "within a period of 1 hr dramatically transformed the incorrigible, vicious, antisocial warrior into a peaceful, cooperative, lovable dog" (687). These effects lasted for up to 7 hours. An initially exciting aspect of CNS-stimulant therapy of hyperkinesis-related aggression was the finding that, after 6 weeks of drug and "psychosocial" therapy, the previously uncontrollable aggressive behavior largely disappeared and remained in remission even once the drug was withdrawn. Corson noted that no tolerance to the drug was observed during the treatment period. These early hopeful prospects have not been borne out by subsequent clinical experience, however.

Barney

In an anecdotal report, Jenny Drastura (1992) describes her personal experiences with a hyperkinetic male Lhasa apso named Barney that had developed a serious aggression problem. Even as a puppy, Barney exhibited incip-

ient signs of a developing aggression problem. He resented being rolled onto his side and resisted various other forms of restraint and grooming. By the time he was 16 weeks of age, he began snapping during routine disciplinary interaction—discipline that involved verbal reprimands only. Barney proved recalcitrant to formal obedience training, biting his owners on three separate occasions while being trained. He was subsequently exposed to a more positive training process, employing food reinforcement and other rewarding activities in exchange for cooperation. Under the influence of such training, Barney proved much more compliant, but his aggressiveness continued to worsen. By the time he was 2 years old, it had become a serious behavior problem:

> Not only did he growl and snarl when challenged on his own turf, he was also beginning to go into a "ragelike" state any time he perceived that he was being threatened. In his rage state, he would withdraw into himself, growling and snarling, actually appearing to become smaller. His growling turned into screeching noises, his eyes appeared red as blood filled the blood vessels in his eyes and his gums turned white. Finally he reached a stage where he could not withdraw any further, and he attacked any object directly in front of him at about a 12 inch range. He appeared to have no peripheral vision. Oddly enough, this rage ended instantly if we yelled "cookie" or "cheese." His body relaxed and he immediately began jumping or dancing for whatever we had promised. It appeared that he had no idea what had just happened to him. (20)

As Barney's condition deteriorated, the owners contacted Victoria Voith for suggestions and guidance. Voith treated Barney with a combination of behavior modification and a panel of psychotropic drugs in an effort to control his ragelike aggressive symptoms. After a series of false starts and dead ends, it was found that Barney's aggressive symptoms were relieved by D-amphetamines. Barney was prescribed D-amphetamine to be taken twice a day. He responded to the medication by becoming more affectionate, more playful, and much less aggressive. The results were strikingly consistent with those described by Corson and coworkers in the case of Jackson.

Two significant divergences occurred between Corson's findings and the behavior of Barney regulated by D-amphetamine: (1) When Barney was taken off medication, his aggressive behavior returned. In Jackson's case, Corson observed a radically different therapeutic course. Instead of recovering after medication was discontinued, aggressive behavior remained quiescent. (2) Corson reported that dogs treated with D-amphetamine did not develop a tolerance to the drug. Barney did develop a tolerance to the drug (albeit after 3 years of treatment). He also exhibited a clear dependency on it. For instance, when he was periodically taken off the stimulant or when the drug simply wore off, he would become even more aggressive than he had been before treatment with the medication. Such heightened aggressiveness may have been the result of a combination of withdrawal symptoms and various neurological side effects of long-term D-amphetamine therapy. It should be noted that Barney exhibited other signs of neurological deterioration, including the development of various repetitive stereotypic behaviors (e.g., chomping with nothing in his mouth) and episodes of bizarre and inexplicable barking episodes.

Cognitive Interpretations and Speculation

Hyperactive dogs appear to be unable to modulate sensory input and to coordinate it with an integrated behavioral output. As the result of such cognitive impairment, a dog may attempt to keep pace and adjust to the changing environment by speeding up its behavior, increasing vigilance, or by intensifying its behavioral efforts to control fleeting events. Viewed from the perspective of a *minimal brain dysfunction,* the observed symptoms of hyperactivity are really the dog's best efforts to establish control over the slippery and transient stimulus events impinging on it.

Stimulus events reaching the attention of such dogs appear to compete for equal and undivided attention, suggesting a failure of cognitive functions dedicated to selectively collecting and processing sensory data and transforming it into information. Under normal conditions, a complex neural *gating* and

comparator system serves to separate relevant from irrelevant sensory input, thus enabling dogs to match their behavior to changing circumstances. Sensory input is conditioned by at least three basic stimulus and contextual dimensions: (1) stimulus sequencing, (2) event boundaries and frames, and (3) figure/ground relationships. In the case of an inadequacy involving stimulus sequencing, dogs may not be able to sufficiently order events along a temporal dimension from which to derive causally meaningful relationships between them. In other cases, a dog may not be able to determine where one stimulus event begins and where another ends. In this case, the stimulus event is inadequately bounded and framed for cognitive representation and, therefore, insufficiently distinct to hold the dog's attention. Lastly, a dog may not be able to place stimulus events (although temporally well ordered and defined) into a spatial context in which they can be perceived as distinct and separate events set against a contextual backdrop. In this case, the event is obscured by competing and irrelevant background information. Of course, all of this is highly speculative but does provide a tentative framework for evaluating possible cognitive-perceptual impairments in hyperactive dogs.

An apparent exaggerated need for novelty and variety is a characteristic feature of many hyperactive dogs. They may be affected by an intolerance for boredom. In fact, some evidence suggests that hyperactive animals may actually be more intolerant of repetitive demands than are normal ones (Mook et al., 1993). Under experimental conditions where behavioral variability is rewarded, hyperactive rats may excel over normal controls. However, in situations requiring repeated performance of a similar response, hyperactive rats show clear signs of a disadvantage or learning deficit. On the positive side, these findings seem to imply that hyperactive animals are better adapted to situations requiring *creative* solutions. Perhaps an evolutionary pressure exists that alternately favors both general styles of learning, depending on changing demands placed on an animal by the environment. In times of change and crisis, a *creative* animal (greater behavior variability) would enjoy a distinct biological and adaptive advantage over its more routine-oriented counterpart. These general findings suggest that hyperkinesis may serve a legitimate and important behavior-diversifying function. This line of reasoning leads to a novel appreciation of the biological and cultural significance of ADHD in children and hyperkinesis in dogs.

Behavioral Side Effects of Hyperactivity

Many comorbid complications and long-term side effects frequently develop in the wake of hyperactivity. Affected dogs are often so behaviorally disorganized that normal developmental processes are adversely impacted. A striking characteristic of most hyperactive dogs is their immaturity. Because hyperactive dogs find it difficult to control their impulses, they are subjected to a high degree of frustration and other emotional tensions. It is interesting to note in this respect that hyperactivity is often most exaggerated during social encounters where such excesses result in a great deal of interactive punishment, disapproval, and rejection. An owner may also become progressively frustrated and respond by escalating punitive efforts or by relying on increasing amounts of isolation in order to manage a hyperactive dog's behavior. Since many attention-seeking behaviors are *active-submission* efforts, threats or physical punishment may serve only to stimulate even *more* of the unwanted behavior in a futile effort to appease the owner.

Not surprisingly, frustrative arousal is often associated with social excesses and hyperactivity. Dogs that are unable to achieve a satisfying social connection with their owners may, as a consequence, try even harder. Unfortunately, the dogs' efforts are rarely successful, and repeated failure may lead them to form corresponding negative expectancies about future efforts. In such cases, frustration is evoked by both obstructed access to the social goal, as well as a failure or deficiency of a dog's behavioral repertoire to achieve it. An expectation of failure may consequently evoke frustrative preparatory arousal whenever the dog is in the owner's presence. Consequently, the dog's moment-to-moment expectations of

pending failure in social settings may stimulate a spiraling escalation of frustration and corresponding social excesses. The thwarted social intentions and motivations underlying unsuccessful social excesses provide a powerful locus for escalating frustration and anxious arousal in the form of attention seeking (i.e., excessive active-submission behavior). Problematic attention-seeking behavior may reflect persistent social frustration, resulting in disorganized and ineffectual social behavior, especially involving active submission. Attention-seeking dogs are not usually satisfied with getting social contact, and giving it to them may only evoke additional compulsive attention-seeking behavior, suggesting the presence of other motivational imperatives at work, besides the satisfaction of proximity or contact needs. Punishment in such cases appears to escalate attention-seeking efforts, underscoring the submissive character of such behavior—the punitive efforts simply serve to evoke more active-submission behavior. Punishment may be effective only if it results in passive submission. Interestingly, such dogs are often highly responsive to shaping procedures using positive reinforcement in combination with time-out, with brief isolation serving to calm them (see *Time-out and Social Excesses* in Volume 1, Chapter 8). The calming effects of brief time-outs away from the owner may work because the procedure removes (stimulus change) the operative cue (the owner) controlling frustrative submission behavior and restores contact only after the dog has calmed down (passive submission).

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6

Aggressive Behavior: Basic Concepts and Principles

But where danger is, grows
The saving power also.

FRIEDRICH HÖLDERLIN, *POEMS AND FRAGMENTS* (1966)

PART 1: INTRODUCTION

CHARACTERISTICS OF DOGS THAT BITE: AGE AND SEX

The etiology of aggressive behavior presents considerable variation from dog to dog. Aggressive behavior is most frequently exhibited by socially mature and intact male dogs (Reisner, 1997), but young puppies can have serious precocious aggression problems, as well. Mugford (1984) reported that among 50 English cocker spaniels the mean average age of dogs with dominance-related aggression was 7.4 months (range, 3 to 24 months). In another group of golden retrievers treated by

Mugford (1987), 24 with aggression problems averaged 2.9 years of age (range, 0.7 to 8.0 years). Of the 24 dogs treated by Mugford, 19 were males, two of which had been castrated. Beaver (1983) found that of 120 dogs with aggression problems (various diagnoses) the mean age was 3 years (range, 9 weeks to 11 years). She reported that 60.1% of the dogs were intact males (14% castrated), with 15.4% intact females (10.5% spayed). Wright (1985) found that the average age of dogs involved in severe attacks was 3 years (range, 0.67 to 10.5 years). All 16 dogs were males. These statistics suggest that considerable variation exists with respect to the time of onset associated with aggression problems. Although most dogs are presented for treatment at 1 to 3 years of age, incipient signs of a developing problem are frequently observed in young puppies, often prior to 4 months of age.

INCIDENCE AND TARGETS OF AGGRESSION

Although a number of studies indicate that dog bites against people represent a serious problem, perhaps even having reached epidemic proportions (Lockwood, 1996), the available statistics are incomplete and inadequate. A notable problem is the dog population sampled. Many of the statistics discussed below were obtained from urban populations that may be skewed by a disproportionate number of aggressive, guard-type dogs. Harris and colleagues (1974) note that urban dwellers frequently keep and socialize aggressive dogs to enhance home security in high-crime areas. Also, the number of social contacts in which bites might occur are probably substantially more numerous in the city than in the suburbs or the country. Consequently, it is difficult to draw any hard and fast generalizations, outside of those directly related to the particular populations sampled. In contrast, the statistical information concerning fatal dog attacks is considerably more reliable and complete. What is extraordinary about fatal attacks is the relative rarity of such incidents when considered in the context of the many millions of intimate contacts occurring between dogs and people every day. Statistically, a child's life is far safer in the presence of its family dog than in the hands of human caretakers or parents.

Overall Situation: Total Number of Bites and Implications

The overall number of dog bites occurring in the United States is widely disputed among reporting authorities. These differences of opinion are attributable (in part) to statistical errors stemming from erroneous population estimates [see Mathews and Lattal (1994)], inconsistent definitions of what constitutes a dog bite, the absence of a consistent and reliable method for tallying dog-bite incidents, and widespread underreporting of dog-bite incidents. A task force on aggression, organized by the American Veterinary Medical Association (AVMA) (Golab, 1998), found that there is a need to standardize the ways in which dog bites are reported. The task force has suggested that standardized forms be produced for collecting information about the age of the bite victim, the circumstances of the incident, the extent of the injuries, and the signalment of the dog. In addition, the task force hopes to better define legal requirements for reporting dog bites and to develop better means for collecting and keeping dog-bite statistics. Unfortunately, the AVMA task force did not include a professional dog trainer—a significant oversight, since most owners with dog-aggression problems turn to such people for advice and guidance.

Despite the inherent limitations involved and the risk for erroneous generalizations, a careful study of relevant statistics is revealing and useful. According to the AVMA (1997), approximately 52.9 million dogs live in the United States. The AVMA figure is somewhat lower than the Pet Food Institute's (PFI) (1999) estimate of 57.6 million dogs, with approximately 37.6% of all American households keeping at least one dog. Calculating the number of dog bites is a much harder statistical task, with the current best guesses ranging from 2 to 5 million dog bites occurring each year. Pinckney and Kennedy (1982) estimated that approximately 2 million people are bitten each year in the United States, with a tenth of these victims requiring sutures, a third missing time away from school or work,

and half receiving permanent scarring as the result of their injuries. Since many minor bites and bites delivered by familiar dogs are not reported, the actual number of dog bites is probably higher than this conservative estimate. In 1996, Sacks and colleagues (1996a) at the National Center for Injury Prevention and Control estimated that approximately 4.7 million people are bitten in America each year. Of these victims, 899,700 persons required medical attention. They estimate that children were 1.5 times more likely to be bitten, and over 3 times more likely to require medical treatment than adults. Besides the emotional and physical pain of dog attacks to the victims, dog bites represent a serious legal and monetary liability to dog owners. The Insurance Information Institute (1999) estimates that dog bites cost the public approximately 1 billion dollars per year in losses, with insurance companies paying out $250 million to resolve dog-bite claims in 1996. State Farm Insurance (1999) alone reported paying nearly $80 million in dog-related liability claims in 1997. According to State Farm Insurance, one in three homeowner claims involving personal injury pertain to a dog bite, with an average payout of $12,000 per bite incident.

Vital Characteristics: Age, Sex, Risk-taking Propensity, Location of Attacks, Time of Day/Season, and Bodily Target of Attack

Children are bitten at a disproportionate rate when compared to other population groups (Gershman et al., 1994). It should be noted in this regard, however, that children are also most commonly associated with homes that keep dogs as pets (Marx et al., 1988; Wells and Hepper, 1997). Approximately 1% of all children brought for emergency treatment are victims of dog bites (Brogan et al., 1995). Adams and Clark (1989) found that 38% of 105 dog owners interviewed reported that their dog had "nipped" at children or had bitten someone—62% of these bites were directed toward family members. The majority of dog bites are directed toward children 5 to 14 years of age (Riegger and Guntzelman, 1990).

Boys are bitten nearly twice as often as girls (Harris et al., 1974). Boys also receive the majority of severe bites (60% to 78%) (Wright, 1991). Sacks and coworkers (1989) found that, among 29 children between the ages of 5 and 9 who suffered a fatal dog attack, 23 (79.3%) of them were boys. The first clear sign of a sexual differentiation of victims is evident in the 1- to 4-year-old group, with 64.2% of the them being boys. A possible explanation for this difference may be due to the amount of time spent by boys versus girls interacting with dogs. Lehman (1928) performed a large statistical study involving 5000 respondents to determine how children spent their time playing. Children of various ages were asked to respond to a series of questions regarding their daily play activities. He found that boys tended to spend more time interacting with dogs than girls did, with both groups showing a steady decline in the amount of time spent playing with pets (both dogs and cats) as they matured. Another possible cause for the uneven distribution of dog bites between boys and girls may be attributable to a boy's greater inclination to engage in risk-taking behavior (Ginsburg and Miller, 1982).

Most bites occur during the summer months (peaking in June) and weekends. On the average day, they are most frequent from 1:00 to 9:00 PM, peaking between 3:00 and 7:00 PM (Harris et al., 1974). Wright (1990) has also reported seasonal and time-of-attack trends. Among 1724 dog bites reported in Dallas, the incidence of attacks peaked between March and May, with 34.6% of the bites occurring during those 3 months. The majority of dog bites (55.8%) took place from 2:00 to 8:00 PM, peaking between 5:00 and 6:00 in the late afternoon. Sacks and colleagues (1989) were unable to detect a similar seasonal trend in the case of fatal dog attacks. Fatal attacks involving pet dogs were actually more common in the winter, whereas stray-dog attacks occurred more often in the fall and least often in the summer.

The majority of bites involving young children are directed toward the face and head, with children under 4 years of age being bitten in the face, head, or neck 63% of the time (Chun et al., 1982; Podberscek

et al., 1990). Beck and colleagues (1975) found that 35% of the bites involving children younger than 4 years of age were directed toward the face. In children between 5 and 9 years of age, this pattern shifts dramatically, with 84% of bites being directed toward the extremities or torso and 18.5% toward the face or neck (Beck et al., 1975). Among a population of children receiving severe injuries, 82% of the bites were directed toward the victim's head or neck.

Dog-bite reports analyzed by Wright (1991) indicate that 87.5% (range, 85.5% to 89.4%) of the dogs involved are owned, with attacks being directed toward family members in 10.5% (range, 5.9% to 15%) of the cases. These estimates probably underrepresent the actual number of persons bitten by their own dog. In a large study involving 3200 children between the ages of 4 and 18 surveyed, 45% had been bitten by a dog at some point in their life. About half of these children were bitten by a neighbor's dog, whereas nearly a third reported being bitten by the family dog (Jones and Beck, 1984).

Emotional Trauma of Dog Attacks on Children

Surprisingly, Jones and Beck found that the experience of being bitten had little effect on the person's later preference for the dog as a pet. This finding has significant implications for the study of cynophobia, since one would expect from the classical conditioning model of fear that a dog bite should have a lasting negative impact on a child's attitude toward dogs.

In fact, some recent and better-controlled research appears to indicate that there exists a significant independence between having experienced a dog bite as a child and the later development of cynophobia or fear of dogs. Two studies are of particular interest in this regard. First, DiNardo and coworkers (1988), utilizing heart-rate changes as a physiological measure of anxiety, were unable to detect a relationship between a previous dog bite and increased physiological arousal when people were tested in the presence of a friendly dog. Second, Doogan and Thomas (1992) found that most cynophobic adults report that their fear of dogs began in childhood, but there is no clear correlation between the frequency of attacks in childhood and the subsequent development of fear toward dogs. The most important factor in the etiology of such fear is the amount of contact that a person had before the onset of fear. People having minimal contact with dogs as children are more prone to exhibit fearfulness as adults. The researchers suggest that prior "noneventful" exposure to dogs may impede the development of phobic reactions in response to dog bites and other sources of fear (e.g., inimical warnings about dogs):

> The role of conditioning events in producing fear of dogs must be considered as nonproven. If such conditioning events do play a causal role then it is only in conjunction with some other factor such as lack of prior uneventful exposure to dogs or in especially susceptible individuals. The present results from children suggest that information transmission may be more important in engendering fear of dogs than studies of adults might suggest. Although most fearful adults report that their fear of dogs began in childhood, it is clear that not all dog-fearful children grow up to become dog-fearful adults, which raises the question of why some children, but not others, eventually lose their fear of dogs. (393–394)

Dogs That Kill

Of particular concern for parents is the possibility of a fatal attack being directed toward an infant or toddler. Although such attacks occasionally occur, most serious attacks are directed toward older children, especially boys. Voith (1984) believes that the majority of fatal or serious attacks directed toward infants are probably instigated by aberrant predatory motivations rather than by sibling rivalry or other commonly cited motivations such as jealousy. Most fatal dog attacks are delivered by dogs known to the victim or the victim's family, with the majority of them being delivered by the family dog or a neighbor's dog. Most of the dogs involved had no prior history of aggressive behavior and attacked without known provocation by the victim (Pinckney and Kennedy, 1982).

FIG. 6.1. These dogs do not fit the stereotypic profile of dogs that might be expected to kill, but they, together with two others not pictured, fatally injured an 81-year-old invalid woman. (Photo courtesy of V. L. Voith.)

It should be emphasized that fatal dog attacks on babies are extremely rare. From 1979 to 1988, the total number of infants (birth to 11 months old) killed as the result of a dog attack in the United States was 25. Children at the greatest risk for exposure to a fatal dog attack belong to the 1- to 4-year group, with 56 toddlers dying from dog attacks over that same period (Sacks et al., 1989). A more recent study by Sacks and coworkers (1996b), covering the years from 1989 to 1994, reported a total of 109 bite-related fatalities, with 57% of the deaths involving children under 10 years of age. Another age group at a higher risk is the elderly, with 18% of the fatal attacks involving persons over 70 years of age (Figure 6.1). The researchers found that 77% of the fatalities involved attacks occurring on the owner's property, with 18% of the dogs restrained and 59% of them unrestrained. Overall, the death rate involving fatal dog attacks has remained relatively constant over the past 16 years, with approximately 15 to 18 fatal dog attacks in the United States each year.

Dog Attacks versus Human Fatal Assaults on Children

Despite the tragic occurrence of dog attack fatalities, the average child is at a far greater risk of being seriously hurt or killed by a parent or relative than by the family dog. A recent report compiled by the U.S. Department of Health and Human Services (1999) found that 1196 children were killed in the United States as the result of maltreatment in 1997. An earlier government study placed that number closer to 2000; that is, approximately 5 children every day lose their lives to maltreatment and child abuse homicide (U.S. Advisory Board on Child Abuse and Neglect, 1995). Over 85% of the perpetrators are either parents (75%) or relatives (10%) of the victim. In addition to deaths, nearly 1 million children experience substantiated or indicated abuse and neglect annually. According to the USDHHS study, children 3 years of age or younger accounted for 77% of the reported fatalities. By way of comparison with dog attack fatalities, according to the aforementioned study

performed by Sacks and colleagues (1996b), during the 5 years between 1989 and 1994, 45 children (from birth to 4 years of age) were killed by dogs. During a similar length of time, extrapolating from the foregoing statistics for 1997, among children 3 years or younger, an estimated 4605 were killed by humans. Given that approximately nine children of this age group are killed by dogs each year, these sobering statistics of child-abuse homicide reveal that it would take dogs over 100 years to kill as many children as are killed by their own parents, relatives, and other guardians on an annual basis. In other words, in any given year, children at greatest risk of abuse are 100 times more likely to be killed by a parent or relative than by the family dog.

Voith and Borchelt (1985) state the threat of serious dog attacks on children in a fair and balanced way:

> Few infants are severely injured by dogs, and the number of infants killed by dogs is very small, probably no more than 10 per year throughout the entire United States. In contrast, many thousands of infants in the U.S. are victims of automobile accidents, burns, drowning, choking, suffocation, and poisoning. It has also been estimated that each day in the U.S. one child under 10 years of age is killed in a handgun accident. Despite the small risk, there is still cause for concern about a dog's reaction to your infant and precautions are well worthwhile. (4)

When fatal or severe dog attacks occur, the situation is often exploited by "expert" media pundits who frequently fail to emphasize the statistical rarity of such anomalies, while pandering to the public's morbid interest in the gruesome details. Overall, the effect is to produce terror and media hysteria over a widespread threat that does not exist. Such incidents predictably spawn demands from dog-hating politicians and other busybodies for immediate action, including stronger animal control regulations and unfair legislation restricting dog breeding and ownership. Obviously, efforts must be made to educate the public about the risk of dog bites and how they can be prevented, but this can be accomplished without resorting to alarmist, unfair, and divisive breed-specific legislation punishing innocent dogs and owners for the actions of a few culpable and irresponsible offenders.

Despite the gloomy appearance of the foregoing statistics, most epidemiological studies have found that the majority of dog bites result in minor physical injury (Podberscek et al., 1990). In a major study by Parrish and colleagues (1959), 88% of the bite injuries treated were judged to be minor, with 2% producing no evidence of injury. This is not to say that serious attacks do not occur—they do and all too frequently—but the majority of dog bites are neither life-threatening nor disabling for the victim. Although dog bites result in relatively minor injuries, it is important that efforts be taken to prevent such attacks. These efforts should include appropriate education for both children and parents (Mathews and Lattal, 1994). Other key preventative measures include early training and socialization of dogs, responsible breeding and selection of dogs that are destined for homes with children, and early behavioral intervention when problems first appear. In addition, children should be taught how to interact more safely with dogs, and parents should become better informed about how to control their children around dogs.

BASIC CATEGORIES

Aggressive behavior is expressed in one of three general ways: threat, defense, or attack. The sort of aggression that a dog exhibits depends on its motivational state and the presence of significant triggers. Konorski (1967) divides aggressive behavior into two general types, depending on the behavioral traits of the organism and the environmental or motivational circumstances present at the moment of arousal (see *Preparatory and Consummatory Reflexes* in Volume 1, Chapter 6). He notes that the same trigger stimulus may elicit either fear or anger in the stimulated animal and consequently result in either defensive or offensive actions. For example, painful stimulation may evoke a massive fear-and-escape reaction in a solitary animal, whereas if the animal is in the presence of a companion, the same stimulation could result in an angry offensive attack (Ulrich and Azrin, 1962). Konorski also points out that the differential display of defensive or offensive behavior is strongly influenced by envi-

ronmental circumstances, noting that an animal threatened on its own territory is more likely to become angry and engage in offensive aggression, whereas the same animal may show fear and react defensively if threatened while in an unfamiliar place. Fear- and anger-elicited attacks are forms of affective aggression, both involving the presence of a high degree of emotional arousal. As is discussed in greater detail below, affective aggression is distinguished from predatory or *quiet-attack* behavior.

Krushinskii (1960) argues that defensive behavior in dogs presents in two characteristic ways: passive and active defensive reactions. Passive defensive reactions take the form of fear and include all types of freeze and flight responses elicited, for example, by loud-unfamiliar sounds or the close presence of strangers. An active defensive reaction, or what Pavlov refers to as a "watch reflex," is expressed in two forms: (1) defensive barking without an effort to bite or (2) defensive behavior that includes an effort to bite. According to Krushinskii, the dog's active and passive defensive behaviors are the result of a combination of various *unitary reactions* that are coordinated to produce complex behavioral patterns having biological significance for the dog as a species. Unitary reactions are variably composed of both conditioned and unconditioned reflexes. However, unlike individual conditioned and unconditioned reflexes, whose pattern of expression is apparent from the beginning (stimulus) to end (response), the unitary reaction is only fully recognized during the final stages of its expression. Unitary reactions are functionally integrated and organized into species-typical behavior patterns and *epigenetic routines* in order to perform various social and biological functions efficiently by means of interacting with the environment. Consequently, although conditioned and unconditioned reflexes variably influence behavioral thresholds (e.g., fear and anger), the functional significance of defensive unitary reactions only become evident as they are organized into integrated species-typical patterns of active and passive defensive behavior.

In general, two broad categories of aggressive behavior exist, intraspecific and interspecific, depending on whether the aggression is directed toward conspecifics or toward other animals not belonging to the aggressor's species, respectively.

Intraspecific Aggression

Intraspecific aggression consists of both ritualized and overt forms of aggressive behavior directed toward conspecifics, that is, individuals belonging to the same species. Most intraspecific aggression is highly ritualized and serves some biologically significant function (e.g., social organization, population dispersion, or sexual selection). In general intraspecific aggression provides a countervailing and distance-increasing function over place and social attachment processes but without breaking down affiliative contact altogether. As such, ritualized intraspecific aggression imposes social order (e.g., the formation of a dominance hierarchy) and territorial limits on the interaction between individuals belonging to the same species. This ordering and distancing function of aggression is especially evident among familiar individuals belonging to the same social group. Whereas aggression directed toward conspecifics belonging to the same group is often highly ritualized and inhibited, aggression toward conspecific outsiders is usually not so well inhibited and may, as among wolves, result in an overt attack and the intruder's death if it cannot put up an adequate defense or escape by running away.

Interspecific Aggression

Interspecific aggression refers to aggressive behavior directed against another species and includes both offensive and defensive elements. Although intraspecific aggression is most often associated with competition between closely socialized animals belonging to the same species, interspecific aggression is most frequently associated with self-protective goals, as, for example, occur when a prey animal defends itself against the attack of a predator. The dog's relationship with humans is complex in this regard, with both competitive and self-protective aggression being exhibited under different situations. Many ritualized

elements of intraspecific aggression are shown toward people with whom dogs are closely socialized. On the other hand, dogs may also exhibit defensive behavior aimed at self-protection and having nothing to do with the establishment of dominance and territory, as appears to be the case in most forms of intraspecific aggression. In the absence of adequate socialization, interspecific aggression predominantly consists of defensive behavior, lacking ritualization and inhibition, and performed with the intention of doing damage.

Many forms of aggression classified as dominance related (see Chapter 8) may be more defensive than offensive. For example, Line and Voith (1986) report that the majority of attacks by dogs diagnosed with dominance aggression occurred while the dogs were being disciplined. Some dogs may interpret human disciplinary actions (hitting, slapping, kicking) as physical threats and react aggressively in an effort to defend themselves. Predatory behavior is often viewed as a form of interspecific aggressive behavior, but, as will be discussed momentarily, predation is not influenced by the same motivational substrates mediating the expression of competitive and self-protective (affective) aggression. In fact, affective and predatory aggression appear to have evolved under independent pressures and are regulated by relatively distinct and segregated neural circuits and hormonal systems. In many ways, predation is more appropriately interpreted as a form of food-getting behavior motivated by hunger and mediated by the seeking system (Panksepp, 1998).

CLASSIFYING AGGRESSION: MOTIVATIONAL CONSIDERATIONS

Significant debate surrounds the question of how to organize and classify the dog's aggressive behavior into functionally discrete and logically coherent categories. Most trainers and counselors have adopted some variation of Moyer's classification system (Moyer, 1968, 1971; Hart, 1980; Borchelt and Voith, 1982; Borchelt, 1983; Beaver, 1983)—a system that has resulted in a great deal of confusion and misunderstanding (see below). Other authorities have argued with varying degrees of cogency for a more simple classification system. O'Farrell (1986), for instance, has proposed a bipartite system, suggesting that canine aggression can be divided into two broad functional categories: dominance aggression and predatory behavior. This scheme places fear-elicited aggression under the same heading with dominance aggression: "'Fear-biting' is commonly distinguished from dominance aggression, possibly because it is felt to be understandable and excusable in a way that dominance aggression is not. It is, however, a variant of dominance aggression" (94). Although simplicity is often desirable, this arrangement is not very edifying or useful when one considers the numerous motivational assumptions it takes for granted and the equally numerous distinctions that it blurs for the sake of Ockham's razor. Further, the scheme stretches the concept of *dominance* in a way that further obscures its meaning and usefulness.

Since it is not clear how fear-related aggression might be used to enhance social status, O'Farrell's position would be made more appealing and defensible if she explicitly replaced the term *dominance* with the term *control related.* However, although such a revision would help to reduce some potential confusion in her scheme, the change would only open up another criticism. Reducing aggressive behavior to a control-related motivation still begs the question with respect to the special attributes of aggression that distinguish it from other control-related activities. Presumably, all voluntary behavior is control-related behavior, but not all voluntary behavior is aggressive, except, perhaps, in a philosophical sense. Furthermore, although many forms of aggression appear to be purposive and control related, some forms of aggression appear to occur as reflexive actions in response to specific triggers. Also, defining aggression as a control-related activity tends to obscure the unique motivational and situational factors differentiating aggression into varied species-typical forms—even predatory aggression logically collapses into a control-related category. Broadly speaking, both affective aggression and predatory behavior are control-related activities, but they are significantly different in terms of functional pur-

pose, evolutionary history, and neurobiological origins [see *Neurobiology of Aggression (Hypothalamus)* in Volume 1, Chapter 3]. The most persuasive reason for adopting the concept of control-related aggression is that it conceptualizes offensive and defensive aggression in terms that are functionally compatible with the instrumental learning paradigm—learning concerned with establishing control over the environment. On the other hand, the underlying motivational factors (e.g., irritability, frustration, or fear) differentiating aggression into different forms represent the preparatory establishing operations facilitating the expression and potential reinforcement of control-related aggression. These emotional unitary reactions (conditioned and unconditioned reflexes) are under the influence of classical conditioning. In combination, instrumental control efforts and emotional unitary reactions converge on situations having species-typical significance for the dog, whereupon the specific intention of aggression is revealed (e.g., territory related, possession related, dominance related, or fear related).

Avoidance Learning and Aggression

Tortora (1983, 1984) has also suggested an alternative scheme for categorizing aggressive behavior. He interprets the development of aggression in terms of avoidance learning, arguing that what many dog behavior consultants refer to as dominance aggression is better understood as *avoidance-motivated aggression* (AMA). Social aggressors may not necessarily be dominant; instead, they may merely be incompetent and unable to respond appropriately under social pressure. Tortora argues that aggressive dogs appear to lack a repertoire of confident skills with which to cope and manage everyday challenges and stressors:

> The data suggest that the initial source of the aggressive avoidance response was one or more forms of elicited aggression such as species-typical aggressive reactions to pain, frustration, discomfort, territorial intrusion, or threats to dominance. Furthermore, it appears that these aggressive responses were exacerbated by trauma or punishment. Finally, the universal lack of behavioral control over these dogs implies that they had few operant alternatives to gain reinforcement by compliance. From the case histories, it seems that these dogs were channeled down a path that allowed their initial innate aggressiveness to come under the control of the negatively reinforcing contingencies in the environment.
>
> The dogs in this study initially behaved as if they "expected" aversive events and that the only way to prevent these events was through aggression. The consequent reaction of the victim and the family, that is, withdrawal, turmoil, and belated punishment, confirmed the dog's "expectations" and reinforced the aggression. This positive feedback loop produced progressive escalation of the aggressive response, and the avoidance nature of the aggression presumably retarded or prevented its extinction. (1983:209)

The treatment program developed by Tortora is essentially a course of obedience training using various procedures, including remote shock, to enhance confidence and social competence. The operative assumption is that dogs exhibiting avoidance-motivated aggression need to learn systematically that they can *safely* control threatening or aversive events without resorting to aggression.

A strength of Tortora's functional analysis is that it rests on a strong body of supporting experimental research (Azrin et al., 1967; Hutchinson et al., 1971). In addition to being elicited by a variety of natural or learned triggers acquired through classical conditioning, aggressive behavior functions motivationally and behaviorally in a variety of ways, such as providing instrumental control over the physical and social environment. Animals can learn to avoid aversive stimulation by responding aggressively and may even learn and perform arbitrary instrumental responses to obtain an opportunity to attack a target provided as a reward (Azrin et al., 1965). The avoidance paradigm also offers an explanation for the persistence of some forms of aggressive behavior, since avoidance learning is marked by a strong tendency to persist over time and resist extinction (see *Fear and Conditioning* in Chapter 3).

Tortora does not reject the notion of elicited aggression (e.g., irritable, territorial, or dominance related), but stresses that the dog's repertoire of species-typical aggressive behavior and controlling natural triggers only represents part of the picture. Although aggression

may be originally elicited by a *natural* trigger, it can subsequently come under the control of conditioned stimuli or *learned* triggers through avoidance learning. In fact, dominant-aggressive dogs frequently do exhibit behavior that appears to be influenced by avoidance learning. A common and often confusing characteristic of dominance aggression is the absence of an adequate trigger to explain the ferocity of the attack. In other words, the magnitude of dominance attacks is frequently far in excess to what one might expect to occur under the operative circumstances present at the time. Such attacks often appear to occur under minimal or no provocation at all. Low-threshold or unprovoked attacks may be explained along the lines of avoidance conditioning, whereby neutral stimuli present at the time of attack may become conditioned or learned triggers via association with unconditioned or natural triggers. As a result, these conditioned triggers may become capable of eliciting aggressive behavior in the absence of natural triggers. In other words, aggressors may learn to anticipate aversive arousal (frustrative, irritable, painful) by association with other stimuli present at the time when aversive arousal led to aggression. As a result, such stimuli may gradually become discriminative signals controlling avoidance-motivated aggression. According to this general account, most aggressive behavior is learned as a means to anticipate and avoid actual or perceived threats, especially threats occurring under circumstances where other means of control are unavailable or ineffectual. Bottom line, according the AMA hypothesis, *dominance* aggression toward human targets appears to be more about *defensive* control than *offensive* status-seeking efforts.

Many attack situations involving defensive aggression (that is, aggression influenced by a component of fear or avoidance) appear to present characteristics consistent with Tortora's AMA hypothesis; however, attacks motivated by anger do not appear to involve an underlying component of fear. The offensive aggressor may exhibit threatening postures and gestures (standing tall and stiff, ears up and turned forward, tail held erect, lips forming an agonistic pucker), behavioral signs indicating confident aggressive arousal—not preparatory fear. The offensive aggressor may learn that threats and attacks serve to secure or protect vital interests and resources. For example, a dog that has learned to threaten and displace its owner in the presence of food may learn through positive reinforcement (that is, the continued possession of food) that such behavior works. Determining whether the particular behavior is under the control of positive or negative reinforcement depends on whether the behavior functions to terminate or avoid stimulation or serves to obtain or perpetuate stimulation. When aggression occurs while the dog is sleeping, resting, or eating, the attack may be analyzed in terms of the perpetuation of these activities or resources, that is, understood by appealing to positive reinforcement. On the other hand, such attacks may also be analyzed in terms of negative reinforcement, especially if the behavior is primarily motivated to terminate the presence of a threat, a source of irritation, or frustration. In general, the determination of whether aggression is defensive (avoidance motivated) or offensive depends on the presence of behavioral signs at the time of attack. However, distinguishing between these two forms of aggression on the basis of postural signs of fear may become progressively difficult in the case of the experienced avoidance-motivated aggressors, who may not exhibit any signs of overt fear, especially as they become progressively confident and sure about the likelihood of success. In general, though, whether defensive or offensive, aggressive behavior aims at establishing control over some intruding target. The notions of positive and negative reinforcement may actually obfuscate the vital concern; that is, aggression is reinforced by the control it succeeds to establish, regardless of the motivational substrate operative at the moment of attack (see *A Brief Critique of Traditional Learning Theory* in Volume 1, Chapter 7*)*. According to this perspective, punishment occurs when the aggressive threat or attack fails to avoid or terminate an aversive-thwarting situation or when it fails to obtain or perpetuate some gratifying activity or resource. These considerations are of vital importance for the effective control and management of aggressive behavior.

Social Dominance and Aggression

One of the most well-studied areas in ethology is aggression, especially aggression exhibited with the apparent purpose of establishing or defending social status or rank (Scott, 1992). The most widely adopted conceptualization of dominance aggression incorporates several interactive components, including an ethological dominance concept, species-typical signalization (gestures and postures signaling agonistic intent and rank—dominance and submission), early socialization, and learning. Dogs and humans both socially organize themselves by rank order (often involving very complex alignments) within a dominance hierarchy. Such organization is accomplished by various means, including the utilization of species-typical gestures and body postures employed to advertise and ritually defend the individual's status against challenges presented by others belonging to the same group. Sometimes, communication breaks down as the result of a misunderstanding or an outright power struggle, giving rise to conflicts and challenges that may escalate into overt attacks and fighting. The role of social dominance in the expression of aggression is examined in detail in *Social Dominance and Aggression* in Chapter 8.

Fear and Aggression

Normally, fear significantly inhibits aggressive behavior and causes the animal to freeze or flee—if it can. A fearful dog usually makes frantic efforts to escape when it feels threatened or is attacked. It is only under circumstances in which escape or appeasement is thwarted that a fearful dog may resort to aggression. First and foremost, the goal of fearful behavior is to escape or control threatening stimulation, with counterthreats and aggression emitted as a last resort. Fear aggression is always a defensive strategy and is most likely to occur when other means of escape or avoidance are thwarted. However, in cases in which fear aggression succeeds, the defensive threat or attack may undergo reinforcement and, under similar circumstances in the future, the behavior may be triggered by conditioned stimuli associated with the original eliciting situation. As already discussed, the result is the development avoidance-motivated aggression—behavior that may closely parallel dominance aggression but remains essentially defensive rather than offensive. Fear aggressors can be distinguished from dominance aggressors by the exhibition of defensive postures indicative of fear (e.g., ears back, tail tucked under the body, nervous snarling, and showing of teeth) and approach-avoidance conflict. In addition, the fear aggressor may engage in barking (a possible repetitive conflict behavior) and other signs of fearful arousal (licking movements) and agitation that occur when it is exposed to eliciting stimuli, such as a doorbell, the approach of a stranger, noisy children, skaters and other similar stimulation, or the approach of other dogs. Typically, the fear aggressor is most likely to threaten or bite when it is suddenly approached by a fear-eliciting person or dog, where escape is preempted (Borchelt, 1983). Once fear aggression has graduated into avoidance aggression, many of the telltale signs of fear may be replaced with increased confidence and reduced latency and occur under minimal provocation.

Fear-related or defensive aggression stands opposite to dominance-related or offensive aggression on the agonistic continuum. Whereas dominance aggression occurs most often in situations involving competitive conflict between conspecifics, stimulated by the coactive influences of frustration, irritability, and anger, defensive aggression is most often directed toward another group member or species, under the influence of acute threat, fear, or anxiety. The tendency to bite out of fear is most commonly seen among shy or nervous dogs that have learned to rely on biting as means of self-defense. Paradoxically, fear-related aggression and dominance aggression sometimes present together in the same dog. The term *bipolar aggression* is a good descriptive term for this condition, since opposing ends of the agonistic continuum appear to be alternately involved, depending on the situation.

Since fear-related aggression depends on the presence of fear for its expression, an important initial step in the counseling process is to make an exhaustive inventory of

the evoking stimuli and situations where aggression has occurred in the past. Detailed information should be gathered concerning the location, magnitude, and type (superficial, puncture, laceration, etc.) of the bites involved. Further, the originating causes of fear and aggression should be fleshed out and clarified. This is not always practical or possible, but an effort should be attempted in every case since the results are often very useful in terms of accurately describing the problem, prognosticating the likely outcome and benefit of training, and helping owners to understand their dog's problem. Fear-related aggression appears to be strongly influenced by predisposing genetic factors. Thorne (1944), for example, found that a single "fear-biting" Basset hound had a tremendous influence on a large group of descendants in terms of their relative fearfulness and reactivity. Of 59 dogs related to this highly reproductive female, 43 (73%) were shy and unfriendly. In addition to genetic predisposition, most etiological profiles show significant causality in terms of early socialization and exposure deficits or the contribution of learning. It is not uncommon to find cases involving all three factors. Voith and Borchelt (1996) suggest that excessive punitive interaction with puppies during house training may play a significant predisposing role in the development of fear-related aggression problems in adult dogs.

Distinguishing the effects of learning from other potential causes of fear is assisted by obtaining a behavioral history and performing a detailed evaluation. Dogs that are affected by a genetic predisposition are distinguished by a chronic, lifelong, and generalized fearfulness. They often suffer heightened or extreme sensitivity to sensory input and overreact in situations involving novel stimuli (neophobia), strangers, or unfamiliar animals. Differentiating cases exhibiting a genetic predisposition from those involving a socialization deficit is not always easy, since undersocialized dogs frequently exhibit similar signs and tendencies as genetically affected individuals. Temperament information about a dog's sire and dam could be helpful in making such determinations. Puppies isolated until week 14, or in cases where they come into the home at an unusually late date from an unknown situation, should be suspected prima facie as suffering a socialization problem. A lack of proper socialization and inadequate or traumatic environmental exposure occurring early in development are commonly associated with adult dogs' reactive fear toward strangers (xenophobia), fear of children (pedophobia), or fear of outdoors and new places (agoraphobia). In cases where fearfulness is the result of learning (e.g., startle, trauma, or abuse), a dog's reactions are usually limited to a more specific range of eliciting stimuli and situations. Of the three aforementioned etiologies, fearfulness stemming from past learning events is usually the most responsive to remedial training, with problems involving a genetic predisposition being the most difficult to work through in my experience. Fear biting suspected of being predominantly under the control of an underlying genetic causation should be carefully assessed and the owner informed of the limited benefits to be expected from behavior modification before proceeding. Although such dogs *may* respond to behavioral intervention, the goals of training should be discussed in terms of amelioration and management—not cure.

Obviously, reducing fearfulness is central to effective behavioral control and modification of fear-related aggression. Several methods have been employed for this purpose with varying degrees of success. The most beneficial techniques involve some combination of graded interactive exposure, counterconditioning, relaxation training, modeling, and response prevention. The most important consideration recommending the use of such procedures is that they help to facilitate the disconfirmation of a dog's adverse expectations of social contact while at the same time encouraging a more affirmative set of expectancies and interactive behaviors.

Cognition and Aggression

Dogs appear to form various prediction-control expectancies about future events based on the accumulation of information extracted from past experiences (see *Prediction-Control Expectancies and Adaptation* in Volume 1, Chapter 7). In general, these expectancies help

to promote a more secure existence by coordinating a dog's behavior relative to the most probable, although not yet actual (certain), circumstances. Prediction-control expectancies are continually undergoing appraisal and modification in order to most accurately fit or *adapt* a dog's behavior to the environment. These expectancies are influenced by emotional concomitants of success (elation) or failure (disappointment). In cases in which a high degree of correspondence exists between what a dog expects to occur and what actually occurs, effects of well-being and confidence prevail; whereas, under opposite circumstances in which their is little correspondence between what the dog expects to occur and what actually occurs, effects of depression and helplessness may ensue. Expectancies are adjusted in accordance with the occurrence of satisfying or distressful emotional concomitants resulting from the confirmation or disconfirmation of expectant arousal or action. For example, when a prediction expectancy is disconfirmed or proves inadequate, then *anxiety* ensues. On the other hand, when a control expectancy is disconfirmed or proves inadequate, then *frustration* ensues. These emotional concomitants of expectancy disconfirmation promote adaptive optimization through the activation of increased sensory vigilance and behavioral invigoration. Adaptive change is mediated through learning, and learning is guided by the affects of anxiety and frustration, resulting from the disconfirmation of prediction-control expectancies. Theoretically, when prediction-control expectancies are fully matched and coordinated with the environment, utopic adaptation is achieved, and further learning is unnecessary and does not occur. Under ordinary circumstances, anxiety and frustration promote learning and adaptive optimization of environmental resources. However, under conditions in which the environment is both highly unpredictable and uncontrollable, then pathological disorganization (learned helplessness) and behavioral disorder (impulsive-compulsive behavior) are prone to follow. In other words, a small amount of anxiety and frustration promotes adaptive success, whereas high levels of anxiety and frustration disturb learning and disrupt behavioral adaptation.

Preparatory arousal, attention, intention, and functional behavior are guided by prediction-control expectancies. Under ordinary circumstances, dogs select courses of action based on cognitive expectancies, unless the particular expectancy has been disconfirmed or the environment provides inadequate information with which to form adequate prediction-control expectancies. Under such circumstances, dogs may depend more on direct sensory information, until a more adequate expectancy is formed. This shift from expectancies to reliance on sensory information may be highly disruptive and stressful. In addition to resorting to sensory information, dogs may also be more inclined to rely on instinctive or species-typical impulses to secure the environment. Under highly threatening social situations which violate a dog's prediction-control expectancies (e.g., *trust*), increased sensory vigilance and behavioral invigoration may facilitate intense aggressive arousal and significantly lower thresholds for aggressive behavior. Unfortunately, as a result, the dog may modify prediction-control expectancies so that, under similar circumstances in the future, it may learn to preemptively prepare and respond aggressively under minimal stimulation and continue doing so until the operative expectancy is disconfirmed.

Although prediction-control expectancies may accurately reflect reality, under the influence of adverse learning dogs may form faulty expectations that may not adequately represent actual circumstances. This risk is particularly problematical in the case of escape and avoidance learning, in which case the avoidance response may preemptively interfere with a dog learning that the response is no longer necessary to control the anticipated threat (see *A Cognitive Theory of Avoidance Learning* in Volume 1, Chapter 8). For avoidance to discontinue, the operative prediction-control expectancy guiding the behavior must be first disconfirmed (e.g., via graduated interactive exposure and response prevention) and replaced with an alternative expectancy more adequately fitted to the actual situation. In addition to forming specific expectancies, dogs also appear to appraise and interpret events in very subtle ways that predispose them to preferentially engage in certain

behaviors rather than others. Cognitive appraisal assists dogs in modulating their moment-to-moment arousal levels as well as finely regulating appropriate actions to achieve a more subtle behavioral adaptation to the environment. These interpretive cognitive functions are especially evident in the case of complex social circumstances requiring a high degree of communication and cooperation, such as play. In the case of play, aggressive elements and sequences are interpreted in terms of the play partner's intention and various play metasignals confirming that the interaction is *just play.* Interpretive appraisal of the social intention of others provides the basis of communication. The mutual communication of intent determines whether competitive or cooperative behavior will ensue between interactants. Communication of intent may not only predict aggressive or affiliative action, it may also define the most likely outcome of the encounter. A highly motivated dog (e.g., starving) may show a very strong intent to defend a bowl of food, sufficient to cause a less hungry potential competitor to withdraw—even though under other circumstances the competitor may be dominant and the aggressor submissive. The way a dog interprets the intention of interaction strongly influences how it will respond to it. Petting or hugging coming from one person may be welcomed and reciprocated with expressions of shared affection, whereas the same actions coming from another person may be interpreted as a threat and, perhaps, evoke an aggressive response. Such interpretations of intent are strongly influenced by the quality of attachment and communication between the human and the dog. Interpretive appraisal of social intention under the influence of high levels of affection, familiarity, and trust appears to promote strong and durable inhibitory effects over aggression between closely bonded interactants.

Another important cognitive influence over aggressive behavior is cost-benefit assessment and risk taking. Engaging in aggressive conflict brings with it considerable risk. Cost-benefit assessment appears to play a significant role in the case of offensive aggression, where the goal is to achieve some benefit or resource. In the case of a starving dog, the risk of injury that may result from fighting is offset by the benefit of eating. In situations where the potential cost of behaving aggressively (loss or injury) exceeds what might be conceivably gained by the action, a dog is more likely to steer away from initiating an aggressive conflict. Aggression is most likely to occur in motivationally significant situations, where the risks of aggression are minimal (costs) and the potential benefits are substantial. Finally, dominant dogs appear to be more inclined to engage in risk-taking behavior, whereas submissive dogs may be more conservative and careful regarding risky behavior. A predisposition to take risks may be a genetically expressed trait that is more characteristic of dominant individuals than submissive ones. Submissive individuals may be genetically prone to avoid risk taking, unless the perception of risk is motivationally offset by a pressing biological need or threat and the potential benefit of success is sufficiently enticing.

A potential factor altering risk assessment abilities is stress. Quatermain and colleagues (1996) have found that stressed mice more rapidly engage in risk-taking behavior than unstressed controls. In the case of dogs, stress may lower thresholds for aggressive risk taking, causing otherwise submissive and compliant dogs to become periodically more irritable and aggressive. Stress appears to impair normal attention and memory functions (Mendl, 1999) and cortical impulse control over subcortical activity (Arnsten, 1998), potentially lowering behavioral thresholds for aggression or liberating species-typical offensive and defensive behavior in response to wrongly interpreted social signals. The systematic reduction of stress is an important aspect of effective behavior therapy. Such treatment efforts may facilitate risk-assessment normalization and improve other cognitive functions involved in the modulation of aggressive arousal and the regulatory control of aggressive behavior. A neural site of particular interest in this regard is the amygdala (see *Limbic System* in Volume 1, Chapter 3), which appears to serve a central role in social communication by mediating direct eye contact,

by interpreting socially significant facial expressions, and by assessing the interactants emotional disposition and intent (Allman and Brothers, 1994). Under the dysfunctional influence of excessive stress, the intent of social signals may be distorted and misinterpreted, causing a dog to respond with inappropriate fear or aggression. The amygdala may play a particularly prominent role in the case of dominance-related aggression (Fonberg, 1988).

A Nomenclature of Aggressive Behavior

Functionally speaking, aggressive behavior, not stemming from idiopathic or pathological causes, can be viewed as an adaptive effort to establish control over some vital resource or situation that cannot be effectively controlled through other means. A variety of motivational and functional factors are presumed to influence the expression of aggressive behavior in dogs (Table 6.1). Obviously, these types of aggression exhibit a great deal of functional overlap. Although useful as a descriptive inventory, the list fails to provide a consistent functional framework for analyzing aggressive behavior. Instead, like other similar lists in the dog behavior literature, it brings together various forms of aggression under the discordant rubric of species-typical elicitors, physiological causes, and functional purposes. As a classification system, such discordance precludes productive analysis and the extraction of general principles.

Moyer (1968) has devised a classification system that is based primarily on stimuli or situational conditions that regularly evoke aggression (Table 6.2). Moyer's inventory of stimulus situations evocative of aggression ends up including general physiological and psychological influences as part of the evocative situation. The inclusion of instrumental learning is particularly confusing and discordant in the framework of the system's stated purpose. Instrumental learning may certainly influence a dog's propensity to bite, but such learning is not part of the evoking situation, at least not in the same sense, for example, as an intruder is part of a situation that evokes territorial aggression. Instrumental learning does not logically belong to the list, especially if other forms of learning such as classical conditioning are excluded as situational influences—an exclusion that makes very little sense, given the inclusion of instrumental learning. But, most importantly, Moyer's taxonomy chiefly fails because it does not properly emphasize the very active and purposive character of aggressive behavior. Aggression is not just passively evoked by an adequate stimulus situation or physiological state. On the contrary, most often, aggressive behavior is guided by an intention to actively control or change the environment somehow, especially those parts of the environment that otherwise resist control or *bite* back.

Moyer's decision to include instrumental learning in his list of evocative situations underscores the vital role that learning plays in the acquisition and expression of aggressive behavior. Aggression is not merely a passive response to circumstances—it is more often an active and purposive effort aimed at obtaining various ends through the assertion of threats or attack. As such, aggression can be adequately understood and controlled only by recognizing that it is motivated and emitted under the influence of both emotional (reflexive) and purposive (instrumental) components. Functional aggressive behavior depends on the presence of significant setting events (broad contextual and motivational variables), transient emotional *establishing operations* (e.g., frustration, irritability, and anxiety), and an evocative target or situation toward which the threat or attack is directed. *The goal of aggression is control.* In effect, Moyer's taxonomy is an incomplete list of setting events, establishing operations, and targets under whose influence aggression is most likely to occur and *potentially result in reinforcement*—that is, result in enhanced control over the environment.

Although some forms of environmental stimulation may at times elicit *reflexive* attack (rage), such behavior is rather rare in comparison to the incidence of functionally integrated and purposive aggression. Aggression is often aimed at controlling the behavioral trajectory of another whose interests or

Table 6.1. Descriptive and functional characteristics of aggression

Behavior	Etiological factors	Description-function
Avoidance-motivated: Often socially insecure and incompetent.	Fear Anxiety Control Learning Socialization	Occurs in situations where the dog has learned that aggression successfully postpones or avoids an aversive stimulus or situation.
Control (dominance)-related: Dogs often lack appropriate boundaries and social inhibitions. Often limited to family members. Occurs around defended areas (e.g., bed, doorways, furniture) or items. Most often observed in male dogs.	Frustration Anxiety Learning Hormonal Genetics Socialization	Aggressive behavior occurring under a variety of situations involving competition and control. Dominance aggression generates social distance and establishes hiearchical stratification or status between socially familar competitors.
Dysfunctional: Explosive behavior may be related to PTSD (see *Low threshold*).	Frustration Anxiety Helplessness Learning Socialization	Occurring under inappropriate stimulus conditions and vastly exaggerated (disproportionate) within the context. Frequently, observed in cases involving dominance aggression.
Fear related: Attacks associated with postural signs of fear (e.g., lowered posture, tail down, ears back).	Fear Anxiety Helplessness Genetics Learning Socialization	Occurs only as a last resort when escape from an intensely fearful situation is not otherwise possible. Fear-related aggression is employed to escape but not to otherwise control or change the situation.
Idiopathic: May involve epilepsy.	Neurologicial Pathology Genetics	Aggression occurring as the result of unknown causes (see Pathophysiological).
Instrumental: Most forms of aggression are affected by learning.	Pain Anxiety Fear Frustration	Aggression enhanced or acquired through classical or instrumental learning but not specific to any single stimulus situation.
Intermale/interfemale: Aggression between females is most often seen among dogs sharing the same residence. Appears with sexual and social maturity.	Fear Dominance Hormonal Genetics Learning Socialization	Provoked by the close proximity of conspecifics of the same sex. Occasionally, dogs will fight with members of the opposite sex, but this is much less common.

TABLE 6.1. Descriptive and functional characteristics of aggression—*Continued*

Behavior	Etiological factors	Description-function
Irritable: Results from painful stimulation associated with injury, various grooming and veterinary procedures.	Pain Fear Frustration Pathology Genetics	Associated with situations involving cumulative stress: crowding, frustration, punishment, pain, and deprivation. Includes threats, biting, and scratching to escape painful stimulation.
Low threshold: Aggressive behavior occurring with little or no apparent provocation or warning. Commonly associated with dominance aggression and so-called springer rage syndrome.	Frustration Anxiety Neurological Helplessness Learning Socialization	A form of dysfunctional agression occurring in cases where normal inhibtions and central control over aggressive behavior is compromised—sometimes referred to as episodic dyscontrol syndrome.
Maternal: May be directed toward inanimate objects when pseudopregnancy is present.	Hormonal Genetics	Occurs when the nesting area or young are approached. Most often directed toward strangers.
Pathophysiological: If should be considered especially in the cases of aggressive behavior with an acute onset and presenting under poorly defined triggers.	Hormonal Genetics Pathology	Results from various underlying physical causes from hypothyroidism (Reinhard, 1978; Dodd, 1992; Dodman and Mertens, 1995) to various neurological disorders (neurogenic) such as epilepsy (Holliday et al., 1970). The role of hypothyroidism in aggressive behavior remains controversial (Polsky, 1993).
Playful: May be directed toward the owner as a nuisance. Excessive mouthing and biting on hands and clothing.	Competition Learning Socialization	Noninjurious aggressive displays during playful encounters, including stalking, pouncing, bumping, gentle biting, and pawing.

(*continued*)

TABLE 6.1. Descriptive and functional characteristics of aggression—*Continued*

Behavior	Etiological factors	Description-function
Possessive: Although commonly associated with dominance-related aggression, it may also occur independently. Appears in puppyhood and thoughout the life cycle.	Frustration Anxiety Learning Socialization	A form of aggression provoked by competition over a possession like a toy or food item.
Predatory: Distinguished from other forms of aggression by the absensce of affective arousal.	Learning Genetics Socialization	Attack released by the presence of prey animals or preylike stimulation. Most often triggered by fleeing movement.
Protective:	Fear Anxiety Learning Genetics Training	Agression emitted in the context of a socially significant other that would not likely occur otherwise.
Redirected: Commonly observed when an owner attempts to break up a dog fight.	Fear Frustration Anxiety Socialization Pain	Threat or attack that occurs when agression is blocked toward a preferred target and directed instead toward a more immediately available one.
Territorial defense:	Fear Anxiety Control Learning Training	Aggression that is directed toward a target intruding on an established territory.
Trained:	Frustration Anxiety Control Learning Play	Aggressive behavior that has been systematically agitated and brought under the control of specific releasing and inhibitory cues (e.g., protection-dog training).
Xenopic: See *Fear-related aggression*.	Fear Anxiety Genetics Learning Socialization	Agression that is directed toward strangers regardless of situation or territorial priority.

TABLE 6.2. Moyer's taxonomy of aggressive behavior

Predatory: evoked by a prey animal.
Intermale: evoked by the presence of a strange male conspecific.
Fear induced: preceded by efforts to escape a threatening situation.
Irritable: evoked by pain, frustration, deprivation, and other stressors and directed toward either animate or inanimate targets.
Territorial: evoked by an intruder entering an established territory.
Maternal: evoked by an intruder perceived as a threat by a mother to her young.
Sex related: evoked by the same behavior that elicits sexual behavior.
Instrumental: enhancement of any of the above through learning.

intentions conflict or collide with the aggressor's interests or intentions (see *Control-seeking Vector Analysis of Territory* in Chapter 7). Control-related aggression denotes any threat or attack aimed at controlling another animal or person, especially in response to social challenges and conflicts or intrusive threats on territory. Finally, control-related aggression is typically employed under adverse conditions (involving heightened frustration, anxiety, or irritability) to control social prerogatives, biological imperatives, or territorial space (any area defended by the dog). Dogs exhibiting aggressive behavior typically do so to secure or defend some vital resource or place against unwanted intrusion or to counter a perceived or actual threat asserted by a rival.

Predatory Behavior

Moyer's inclusion of predatory attack as a form of aggression alongside fear-induced or irritable attack is questionable and potentially misleading. As previously mentioned, predatory behavior might best be treated under some independent category such as "killing for food." This seems appropriate, since predatory behavior is not primarily motivated by affective arousal (anger). In addition, predatory aggression or *quiet attack* typically occurs without signs of sympathetic arousal. In contrast, affective attack is distinguished by the presence of strong sympathetic arousal and anger. Predatory behavior appears to belong to a distinct behavioral and neurological system operating independently of affective aggression, perhaps involving the appetitive seeking system (Panksepp, 1998). An interesting neurobiological finding in this regard is the observation that the neurotransmitter norepinephrine inhibits predatory aggression while facilitating affective aggression like fighting (Siegel and Edinger, 1981). These findings (and many others like them) support the assumption that predatory aggression and affective aggression are mediated by very different biological and behavioral systems (see *Neurobiology of Aggression* [*Hypothalamus*] in Volume 1, Chapter 3). Although predation belongs to an independent motivational system, predatory behavior may be influenced by coactive anxious and frustrative influences that may ultimately lead to the expression of *affective aggression,* a possibility emphasized by Panksepp:

> Of course, this does not mean that the whole predatory attack sequence or any other real-life emotional pattern ever remains under the control of a single emotional system. A predator surely experiences irritability or frustration if the prey struggles so vigorously that it seems liable to escape. Thus, in real life, there are sudden shifts in emotions depending upon the success or failure of specific behavioral acts, as well as in the changing cognitive expectations and appraisals of each situation. (193)

None of the foregoing should be construed to imply that predatory aggression is innocuous or in any sense less dangerous than other forms of canine aggression. Predatory motivations have been implicated in several cases involving vicious maulings and deaths of humans by dog packs (Borchelt et al., 1983). In one of these cases, a large pack of eight dogs, with a known history of predatory behavior, attacked and killed a 14-year-old boy who was riding a motorcycle. Reportedly, the pack had been observed earlier attacking a deer that they had brought down but that managed to escape. This incident occurred approximately 1 hour prior to the attack on the boy. In another incident, a pack of dogs attacked an 11-year-old boy who survived severe injuries to report hearing the dogs "baying, as if chasing something" approximately 15 minutes before the attack. In both cases, there appears to have been a frustrated or redirected predatory motivation involved in the attacks, suggesting that some forms of "predation" are motivated by more than simple hunger and nonaffective neural circuitry. Another case involved a pack of several dogs that was kept by an elderly couple in rural Indiana (Figure 6.2). The dogs, which were permitted to run free, attacked a 10-year-old girl riding her bicycle near the couple's property. In an effort to escape the attack, the child ran into a nearby wooded area, where she was later found dead. The child received numerous wounds and parts of her flesh had been torn away and apparently eaten by the dogs (Borchelt et al., 1983). Winkler (1977) reviews the case histories of 11 fatal dog attacks and cites "threatening behavior or territorial invasion" as the most common causes, without mentioning the possible role of predation or a history of predatory behavior in the dogs involved. Although not mentioned specifically, several of the cases he describes are not entirely inconsistent with a predatory interpretation. Incidentally, of the nine cases where the sex of the dog was known, males accounted for seven of the attacks, with the remaining incidents involving a female and a male and female pair. These data suggest that male dogs may be at a significantly greater risk of delivering a fatal attack than are female dogs.

Genetics and Aggression

There appears to exist a strong heritable factor affecting the predisposition of dogs to behave aggressively. Numerous studies have identified a genetic influence affecting animal behavior in the opposing directions of increased fearful behavior, on the one hand, and increased aggression, on the other (see *Genetic Predisposition and Temperament* in Volume 1, Chapter 5). In general, domestication has exerted selective

Fig. 6.2. Under the influence of packing behavior, large groups of dogs can represent a serious predatory threat. These dogs were involved in a fatal attack on a young girl who was riding her bicycle near their home property. (Photo courtesy of V. L. Voith.)

pressure toward behavioral thresholds conducive to reduced fear and aggression, thereby making dogs more socially responsive and tamable by humans (Price, 1999). Although the general trend has been toward a reduction of fear and aggression, significant variations of excitability exist between breeds and individuals within these different breeds. With respect to aggression, some dog breeds appear, on the whole, to be more aggressive and reactive than others to emotionally provocative stimulation. Scott and Fuller (1965), for example, found clear differences in the aggressive behavior of different breeds emerging at an early age. Of the five breeds observed and tested, they found wirehaired fox terriers to be the most aggressive, basenjis and shelties somewhat less aggressive, and beagles and cocker spaniels much less aggressive. Hart and Hart (1985b) analyzed the cumulative opinions of 48 veterinarians and 48 obedience judges with respect to the ranking of 56 breeds according to 13 behavioral traits. They found that the surveyed professionals shared significant uniformity in their assessment of various traits, enabling the authors to perform a cluster analysis for the various breeds represented in terms of such things as their relative aggressiveness, trainability, and reactivity. Their results show some conformity with Scott and Fuller's earlier findings. For example, the fox terrier is included in the cluster characterized by "very high aggression, high reactivity, medium trainability," whereas beagles and cocker spaniels are included together under the cluster "high reactivity, low trainability, medium aggression." Although such statistical studies as the above represent a good starting point, the results are difficult to generalize because they are limited to personal opinions about behavior—not objective assessments. Even the opinions of professionals are subject to considerable individual and cultural bias. In other words, the study tells us more about how veterinarians and obedience judges feel about the behavior of various breeds than it tells us about the actual behavior of the breeds specified. To make the results reliable with respect to dog breeds, they must be validated by comparison with more objective assessment tests and experimental observations of breed differences, such as provided by Scott and Fuller's work.

A putative heritable factor in the expression of dominance-related aggression has been identified in the English springer spaniel (ESS). As the result of a random national survey of ESS owners, Reisner (1997) found what appears to be a significant breed disposition toward developing dominance-related aggression. She reported that 26% of the ESS had bitten someone, with 65% of those persons bitten being family members or people with whom the dog was familiar. In addition, 48% of the dogs had growled at, snapped at, or bitten family members in a dominance-related context. Finally, the tendency to exhibit dominance aggression was associated with dogs coming from one particular kennel, suggesting the possibility of a popular sire effect. The influence of breed predisposition is apparent in some epidemiological studies of reported dog bites (Wright, 1991). Although mixed breeds are most often implicated in biting incidents, representing between 41.1% and 47.4% of bites reported, some specific purebred dogs appear to represent a greater risk than others. For example, Gershman and colleagues reported that German shepherds and chow chows were most likely to bite nonhousehold members, victims who were often children. It should be emphasized, however, that interpreting breed-related bite statistics is fraught with difficulties (Lockwood, 1995), not the least of which is breed identification. Many dogs may be misidentified and lumped together under a particular breed. Also, as Wright points out, statistical bite rates relative to breed must be carefully weighted against the numbers of a particular breed living in the geographical area from which the sample is derived—a requirement that is not usually satisfied by statistical analyses comparing dog bite rates by breed.

Hormones and Aggressive Behavior

Increased competitiveness and aggressive behavior are often associated with hormonal changes occurring around puberty, a biological change that may lower the threshold for several significant sex-related behavior patterns, including intermale and interfemale aggression. While lowering the threshold for

general activity, urine marking, and aggressive behavior, the threshold for pain and fear may be elevated under the influence of these various hormones.

Stress Hormones and Aggression

The effects of endogenous hormones on aggressive behavior are evident in wild canids. A lower threshold for aggressive behavior is exhibited by both male and female wolves during the annual mating season, when both sexes show an increased tendency to engage in sex-related aggressive behavior (Derix et al., 1993). This sharp increase in aggressive behavior is probably mediated by a number of interacting hormonal systems. The alpha female can be particularly intolerant and hostile toward her female subordinates. McLeod et al. (1995) have shown that the upsurge of aggressive activity among captive wolves is especially stressful (by cortisol measures) on the lowest-ranking female and the second-ranking male.

Increased corticosteroid levels may play an indirect role in regulating sexual and competitive activity among wolves. Only the dominant female comes into full estrus and whelps young. Estrus in subordinate females is suppressed by some external cause, possibly as the result of the dominant female's continuous harassment and badgering before, during, and after the mating season. Estrus may be blocked by stress-mediated mechanisms involving corticosteroid secretions or related physiological mechanisms, such as stress-mediated suppression of luteinizing hormone (Sapolsky, 1990, 1994). In addition to impeding reproductive activity in subordinate females, stress produced by aggressive interaction between wolves appears to reduce the sex drive of subordinate males, as well. Consequently, the increase of aggressive interaction during the mating season may serve to "disable" rivals sexually and competitively, while helping to achieve an optimal physiological state for reproduction in the dominant or alpha pair.

It is interesting to note in this regard that Sapolsky (1990) found that dominant males among free-ranging olive baboons showed distinct differences in cortisol concentrations, depending on the presence or absence of five personality traits. Dominant baboons were most likely to have optimally low cortisol concentrations, if (1) they were able to differentiate between threats and neutral interaction, (2) they initiated the fight with the threatening rival, (3) they won the fight they initiated, (4) they exhibited differentiated behavior after winning or losing a fight, and (5) they redirected aggression toward another baboon when they lost a fight. Dominant males not exhibiting these traits tended to have cortisol levels similar to those of subordinate males.

Sex Hormones: Estrogen, Testosterone, and Progesterone

Estrogen (estradiol) levels are highest during proestrus, with progesterone levels increasing as the female enters estrus. Progesterone appears to exercise a modulatory effect over estrogen, and only after estrogen levels begin to fall will the female become receptive toward the male. Also, as estrus is approached, circulating testosterone in female dogs reaches plasma levels that are comparable to those in male dogs (Olsen et al., 1984). The various sex hormones are closely related steroidal compounds, with testosterone being easily biosynthesized from progesterone and estradiol synthesized from testosterone (Johnson, 1998).

Estrogen affects dog behavior in many ways: it increases general activity levels, promotes increased urine output and marking, increases vocalization, and stimulates nervous arousal in female dogs (Hart, 1985). All of these changes are the result of estrogen's threshold-lowering effects on the female brain, especially involving target areas mediating the expression of proestrus sexual behavior needed to attract a mate. Progesterone, on the other hand, appears to exercise an opposite effect to that of estrogen by generally elevating behavioral thresholds and asserting a calming effect on dogs and enhancing their receptivity to intimate contact. In high doses, progesterone may even induce general anesthesia. Not all practitioners agree on the anti-aggression effects of progesterone. For example, Overall (1997) directly implicates progesterone as an aggression-facilitating hor-

mone, noting that "high levels of aggression in hamsters are associated with the presence of progesterone" (97). Although progesterone may facilitate certain forms of aggression under the influence of certain hormonal environments in certain species (Archer, 1988), the general contention that progesterone promotes aggressive behavior does not appear to be supported by the weight of experimental evidence (Kislak and Beach, 1955; Fraile et al., 1987) and the clinical impressions of many practitioners who use progesterone to control aggressive behavior in dogs. Several laboratory and clinical reports have noted the threshold-elevating effects of progesterone on aggression in both male (testosterone environment) and female (estrogen environment) animals, including intact dogs (Voith, 1980c; Joby et al., 1984) and other domestic species exhibiting undesirable aggressive behavior (Hart, 1985; Houpt, 1991). As of 1991, Houpt described the progestins as the "most effective pharmacological treatment of aggression now available" (66). Progestins in the form of megestrol acetate (Ovaban) or long-lasting injections of medroxyprogesterone (Depo-Provera) *were* frequently administered to control aggression in dogs. Unfortunately, progestins produce a number of potential side effects, including diabetes mellitus, mammary tumors, sterility in intact males, and excessive weight gain. Coupled with the growing popularity of psychotropics, the use of progestins has become much less common. In combination with appropriate behavior modification, however, progestin therapy remains a viable short-term adjunctive treatment for the control of some forms of intractable intermale aggression and other sexually dimorphic behavior problems (Hart and Eckstein, 1998).

Adult sensitivity to androgens and estrogens may be influenced by perinatal exposure to these sexual hormones. Simon and Whalen (1987) found that female mice treated with testosterone or estrogen on the day of birth exhibited an enhanced responsiveness to the hormone upon reaching adulthood. Testosterone-treated mice showed increased aggressiveness in response to testosterone but not to estrogen, whereas estrogen-treated mice selectively responded to estrogen but not to testosterone.

Male and female sexual hormones play an important regulatory role in the expression of sex-related intraspecific aggression. Whether such hormones play a significant role in the expression of interspecific aggression (e.g., toward people) remains an open question. Although testosterone has been often implicated as a facilitating hormone, its role in the expression of aggressive behavior is anything but clear and straightforward. Both androgens and estrogens appear to facilitate aggression, especially during the mating season. Perhaps the facilitative effects of sex hormones on aggression are mediated indirectly by the activation of sex-related emotions and drives, making aggression most likely to occur in the presence of species-typical triggers shown by conspecifics operating under the influence of similar hormonal changes.

Effects of Castration on Aggressive Behavior

The importance of sexual hormones for the modulation of aggressive behavior has long been recognized. However, the effect of hormones on dog behavior is ambiguous and highly variable. Endogenous sexual hormones appear to play a role in the development of some behavior problems (Borchelt, 1983; Wright and Nesselrote, 1987). The relationship between androgens and unwanted behavior is especially evident in the case of aggression, where male dogs present much more often than females—as much as 90% more often by some estimates (Voith and Borchelt, 1982). In general, males also present more frequently than females with other common behavior problems (Hart and Hart, 1985a), including playfulness, destructiveness, snapping at children, territorial defense, and general activity excesses. According to the Harts' study, females are more trainable, easier to house train, and more affectionate. Areas where no significant differences between the sexes were found include watchdog barking, nuisance barking, and general excitability. Voith and Borchelt (1996) reported similar findings indicating that male dogs present more frequently with behavior problems than females (Figure 6.3).

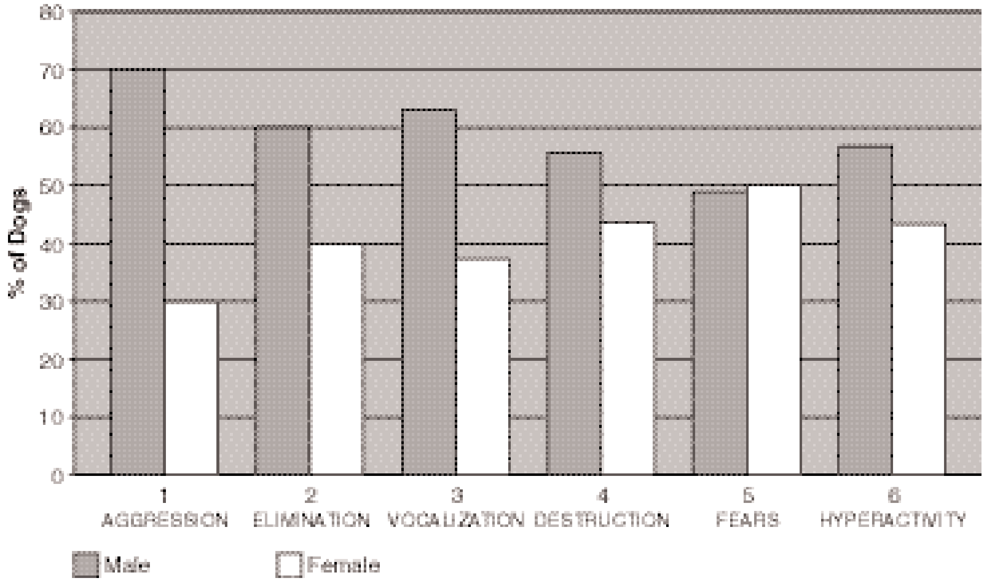

FIG. 6.3. Distribution of behavior problems by sex (N = 1718). Males tend to present more often with various common behavior complaints, which suggests the presence of a hormonal influence underlying the development of some behavior problems. From Voith and Borchelt (1996).

From such data, one might suppose that a more or less direct causal connection exists between the presence of male hormones and increased tendency to behave aggressively. However, such a robust causal relationship between hormones and aggression does not appear to exist. This lack of a definitive cause-effect relationship is evident in the highly variable effect of castration on behavior. Contrary to common belief, castration often fails to affect offensive and defensive aggression significantly; neither does it typically have a significant effect on a dog's general activity level. In general, castration appears to exert its strongest influence over sexually dimorphic behavior patterns, such as intermale aggression, urine marking, mounting, and roaming. Neilson and coworkers (1997) found that such behavior was reduced between 50% and 90% following castration.

Many studies have been performed to evaluate the effects of castration on male behavior. For instance, Beach (1970) carried out a series of experiments investigating the effects of castration on the sexual behavior of dogs. The dogs included in his study were experienced copulators. If testosterone predominantly controls or mediates the expression of copulatory behavior, then one would expect to observe a sharp decline in sexual activity in castrated dogs. However, Beach found that castration had limited effects, with no apparent effect on sexual response latency or mounting frequency in the dogs he observed over the study period, though he did find a reduced frequency of intromission and more brief durations of coital lock.

These findings are consistent with the effects observed after castration on other sexually dimorphic male behavior patterns like aggression, roaming, urinary scent marking, mounting, and intermale fighting. Although such behavior patterns are not always entirely eliminated by castration, their frequency and magnitude may be reduced—occasionally very significantly so. In the case of agonistic displays, one should expect a slight general modulation in the direction of reduction, especially in terms of the intensity/duration of episodes and the tendency for aggression to

escalate. Also, the denouement phase following an episode may be much more steep following castration than before. The effect of castration is one of degree and subtlety—an effect that is often unobserved and unappreciated by the owner.

Some hormonal factor probably exists in the etiology of dominance aggression, since males exhibit the behavior problem more often than females, but the cause and source of this effect may be largely independent of a dog's adult sexual status. The most likely mechanism for the effect of hormones on aggressive behavior is androgen-mediated perinatal differentiation of neural tissue. Early ontogenetic exposure to sex hormones may facilitate the elaboration of sexually dimorphic circuits modulating respective threshold differences between males and females for the display of aggressive behavior as adults.

If testosterone actually plays a significant role in the expression of aggression, one might reasonably expect to see increased signs of it between 6 to 8 months of age, when dogs undergo an endogenous surge of androgen activity (Hart, 1985). Although many dogs do appear to go through an *adolescent adjustment phase* around this period, it is not a statistically significant time frame for the expression of dominance-related aggression, although dogs may become more competitive and difficult and become more aggressive toward other male dogs. Tinbergen (1958/1969) describes some of these apparent and dramatic effects of the adolescent hormonal surge observed among free-ranging huskies in Greenland:

> We followed the behavior of two young males carefully and found, to our surprise, that when they were about eight months old they suddenly began to join their pack in fights with their neighbors. In the very same week their trespassing upon other territories became a thing of the past. And it was probably no coincidence that in that same week both made their first attempts to mate with a female in their own pack. (34)

Castration is often recommended as a means for controlling dominance-related and other forms of aggression (Borchelt and Voith, 1986). The most commonly cited study concerning the therapeutic efficacy of castration on behavior was performed by Hopkins and colleagues (1976) (Figure 6.4). Unfortunately, the study examined a very small sample of dogs (N = 42) and was poorly controlled. The authors noted striking improvement in dogs exhibiting various behavior problems, including roaming (16 dogs, 90% improved), mounting (15 dogs, 67% improved), intermale fighting (8 dogs, 62% improved), and urine scent marking (10 dogs, 50% improved). Both territorial aggression (8 dogs) and fear-related aggression (4 dogs) showed no improvement following castration: "The subjective reports of the present study substantiate the contentions by others that only aggressive behavior toward other males is altered by castration" (1110). One potential source of error in the study was the fact that most of the dogs (37 of 42) involved were castrated to curb an unwanted behavior problem in the first place, perhaps biasing the owners' observations to some extent in the direction of a placebo effect. The owners might have also picked up a few tips on how to control their dog's unwanted behavior, thereby confounding the results. Additional support for the putative benefits of castration on dominance-related aggression have been reported by Neilson and colleagues (1997), who found that 25% of dogs exhibiting aggression toward family members improved between 50% and 90% after castration.

Finally, testosterone appears to be released following competitive victories, whereas a decrease of circulating testosterone follows defeats (Kreutz et al., 1972). The differential increase or decrease of testosterone may affect the relative physical size (anabolic effect) of dominant and subordinate animals, lower aggression thresholds, and increase the magnitude of aggressive behavior. Increased testosterone levels may also provide a source of positive reinforcement for the successful combatant, perhaps promoting feelings of well-being and elation that occur as the result of the victory. Testosterone appears to facilitate aggressive arousal and preparatory reflexes conducive to agonistic success. For example, the direct stare and focused readiness commonly

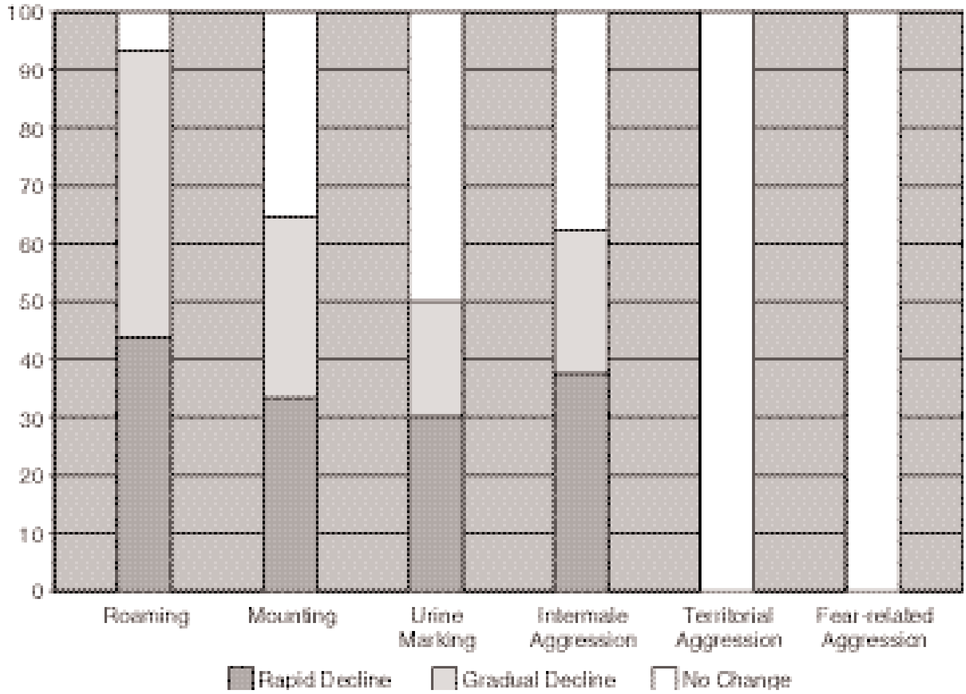

FIG. 6.4. Percentage of dogs exhibiting behavior changes involving various problems following castration. After Hopkins et al. (1976).

preceding dominance contests may be mediated by testosterone. Many studies involving a variety of species have shown that testosterone enhances selective attention in the direction of the target while simultaneously reducing distraction to extraneous stimuli (Archer, 1988). Attention control is a significant factor in the modification of such behavior. Once attention is frozen on the target, it is very difficult to disrupt or divert it, making it of utmost importance to capture the dog's attention during the earliest stages of aggressive arousal. In addition to possibly reducing the reward value of successful aggressive competition, castration may serve to reduce preparatory arousal and decrease the dog's ability to focus its attention fully on the target of attack, thereby making it more easy to divert or disrupt the dog's agonistic intentions and direct the dog into incompatible counterconditioning activities. Consequently, although castration alone may not eliminate aggression, it may make aggression problems more responsive to management and control efforts.

Effects of Prepubertal Castration on Behavior

Some veterinarians and humane groups have promoted early castration as a viable population and behavioral control measure, claiming that prepubertal castration produces superior effects over the current practice of performing castration and spay surgeries at 6 months of age. The evidence supporting this opinion is mixed and controversial. For example, on the pro side of the debate, Lieberman (1987) reports findings based on the results of a questionnaire generated by the Medford, Oregon, SPCA spay and neuter program. The study collected and compared information on about 400 dogs that had been castrated at different ages. The sample was divided into two groups: (1) 200 puppies castrated at 6 to 12 weeks of age, and (2) 200 puppies castrated after 6 months of age. According to Lieberman's survey, the male dog's unwanted sexual and aggressive behaviors were significantly reduced by prepubertal castration when

compared to the group of dogs castrated after 6 months of age. If valid, these findings contradict the observation by Hopkins and colleagues (1976) that the "age of the dog does not seem to have a pronounced influence on the effectiveness of the operation" (1110).

On the con side, Lieberman's findings have been challenged by a controlled study carried out by Salmeri and coworkers (1991), who found that puppies castrated at both 7 weeks and 7 months exhibited little positive difference in significant behavioral parameters (for example, barking, playfulness, aggression toward other dogs, affection toward people, and outgoing nature)—*all significant traits were unaffected by castration.* The only behavioral traits influenced by castration were excitability and general activity, but both in a direction opposite to what one might expect; that is, *dogs castrated early in life tended to become more excitable and active than intact controls.* Even in cases involving intermale fighting, few dogs exhibited significant improvement after castration, although the tendency to fight appears to have been modulated to some extent. Perhaps castrates are less attractive as aggressive opponents for intact males. Finally, Jagoe and Serpell (1988) question the effectiveness of prepubertal castration in 6- to 12-week-old puppies, arguing that the surgery may be detrimental to a dog's health, but they present no significant evidence to support their concern and warning. Although the scientific evidence is mixed, the selective use of early castration might be seriously considered in puppies exhibiting signs of excessive aggression at an early age.

Effects of Spaying on Female Aggressive Behavior

Voith and Borchelt (1982) reported observing a tendency of some female dogs to exhibit an increase in dominance-related aggressive behavior after spaying. The authors speculate that female dogs displaying such tendencies may have been exposed to fetal androgenization, resulting in their malelike behavioral characteristics (see *Perinatal Androgenization* in Chapter 7). Spaying may predispose such dogs to express these undesirable androgynous traits. O'Farrell and Peachey (1990) observed a similar effect in a subgroup of spayed female dogs. They compared the behavior of 150 spayed females with a matched (breed and age) control group of 150 nonspayed females. Spayed females showed a significant increase in dominance-related aggression following surgery, especially if they were under 1 year of age and had exhibited aggressive behavior prior to spaying. In addition, Podberscek and Serpell (1996) have reported that females spayed *before* exhibiting aggression were more likely to exhibit aggression toward children.

Progestin as a Testosterone Antagonist

Joby and colleagues (1984) performed a series of studies to investigate the effects of oral progestins on the behavior of intact male dogs. The sample included 163 dogs with a variety of behavior problems, ranging from dominance aggression to destructiveness. The dogs were administered a daily dose of megestrol acetate (1 mg/kg or 4 mg/kg—30 dogs required the higher dose) over the course of 2 or 3 weeks of treatment, depending on the dog's response to treatment. Most of the dogs exhibited more than one unwanted behavior problem. Of the 163 dogs presented for treatment, 123 (75%) showed improvement at the conclusion of a brief exposure to megestrol acetate. An interesting aspect of the study is the broad effect that progestin treatment had on remote behaviors not directly related to a sexual motivation, such as dominance-related aggression (79% improved), fear-related aggression (71%), destructiveness (79%), and excitability (73%). The primary side effects reported (in 36 dogs) by the authors was an increase in appetite and lethargy. After 3 months off medication, many of the dogs continued to exhibit lasting improvement, although some had relapsed somewhat. Recidivism was especially evident in the case of dominance aggression and household urine marking. The broad benefits of progestin are probably due to its general tranquilizing and anesthetic effects (Knol and Egberink-Alink, 1989a,b).

Note: Although the authors reported minimal side effects, the use of progestin therapy is now widely criticized because of the availability of alternative medications and the potential for serious side effects resulting from long-term use of such hormones.

Pseudopregnancy

Pseudopregnancy or *pseudocyesis* is a hormone-mediated condition that may reduce functional thresholds for aggressive behavior. Pseudopregnancy occurs in female dogs, usually 6 to 8 weeks after estrus, but in some cases not presenting for 4 or 5 months after estrus. In addition to mammary enlargement or lactation, various behavioral signs may present with the condition, including toy adopting, nesting behavior, hyperactivity, destructiveness, and aggression. Aggression thresholds may be generally lowered during the period of pseudopregnancy, with aggressive behavior being particularly likely to occur when the dog's nesting area or toy surrogates are approached. Destructiveness involving digging into sofas and carpeting may also occur during pseudopregnancy. Voith (1980b) has speculated that pseudopregnancy may have served an adaptive function for the dog's ancestors. She argues that the physical and behavioral changes associated with pseudopregnancy may be the result of evolutionary pressures favoring the communal care of young by closely related females belonging to the mother's group. Spaying is commonly recommended in the literature to control the problem (Houpt, 1991); however, spaying a dog while she is still exhibiting signs of pseudopregnancy may significantly protract the condition (Voith, 1980b), perhaps causing it to persist for years in some cases (Harvey et al., 1999). Consequently, spaying should be undertaken only after signs of pseudopregnancy have disappeared (approximately 4 to 6 weeks). Further, some females may develop signs of pseudopregnancy only after spaying, perhaps helping to explain some of the increased incidence of aggression in females after the surgery. In this regard, Borchelt (1983) found that spayed females were significantly more likely to engage in possessive aggression than intact counterparts. Further, in the only cases involving dominance aggression in intact females, it was later discovered that the females were under the influence of pseudopregnancy. Symptoms of pseudopregnancy are often controlled with sex hormones [e.g., progestins (Hart and Hart, 1985a)].

NUTRITION AND AGGRESSION

A great deal of speculation exists concerning the effects of nutrition on behavior, but little scientific knowledge is known about these effects. Animal behavior consultants commonly cite this or that nutritional imbalance as being responsible for causing or predisposing dogs to a exhibit a particular behavioral problem. Recommendations ranging from supplemental B complex for aggressive behavior to massive doses of calcium and other minerals for destructiveness have never been demonstrated clinically or in the laboratory. Campbell (1992), for example, claims that a positive correlation exists between relative protein/carbohydrate proportions in a dog's diet and general excitability levels. High protein levels supposedly decrease excitability while at the same time producing various benefits such as increased trainability. In the opposite direction, high carbohydrate levels are believed to increase excitability and promote distractibility. In addition, he recommends supplementing his stress diet with B complex as nutritional "insurance," even though the dog appears healthy without it. Unfortunately, no experimental data are presented to support these various recommendations or the hypotheses on which they are founded.

Over the past several years, a growing concern has been expressed regarding the effects of food coloring and chemical preservatives on the development of hyperactivity and other behavior problems (see *Dietary Factors and Hyperactivity* in Chapter 5). One result of this concern has been the production of a new generation of diets containing fewer additives—a change in dog food manufacturing that can do no harm, but the potential good of such diets is not clearly known or demonstrated. Research on this topic is scanty and, at present, little scientific evidence exists showing a direct causal relationship between food additives and the incidence of behavior problems in dogs.

However, some evidence does suggest that adjusting dietary protein levels may provide a viable means for influencing the behavioral thresholds of some forms of aggressive behavior (see *Diet and Serotonin Activity* in Volume

1, Chapter 3). For example, Mugford (1987) reported observing a significant decrease in aggressive behavior in a group of golden retrievers after they were placed on a low-protein diet. More recently, a multiclinic study that compared the effects of low-protein versus high-protein diets on aggressive behavior in dogs found that reducing dietary protein levels exerted a beneficial influence in dogs exhibiting territory-related aggression with fear (Dodman et al., 1996). The strongest evidence for a linkage between aggression and dietary protein levels has come from basic brain research. Numerous studies have indicated that dietary protein levels significantly affect the amount of tryptophan reaching the brain for the manufacture of serotonin (Spring, 1986; Christensen, 1996). Paradoxically, high levels of circulating protein in the blood may deprive the brain of adequate tryptophan. This effect is due to a transport mechanism responsible for the selective transfer of nutrients from the blood into the brain. When the blood contains high levels of protein, other relatively more abundant circulating amino acids compete with tryptophan for a limited number of transport molecules, thereby causing an impediment of tryptophan transport into the brain. This situation can be nutritionally modified by simultaneously lowering dietary protein levels while increasing the intake of carbohydrates. The ingestion of carbohydrate-laden foods stimulates the secretion of insulin. Insulin biochemically alters competing amino acids, causing them to move into surrounding muscle tissue. The net result is that tryptophan obtains a numerical advantage over other amino acids competing for limited transport channels providing passage through the blood-brain barrier.

Serotonin serves many important functions as a neurotransmitter, especially the management of stress, impulse control, and mood regulation. Decreased serotonin activity is associated with depression and increased irritability. Many antidepressant psychotropics are believed to work by increasing serotonergic activity. When serotonin levels are low, dogs may become more impulsive and irritable and exhibit a lowered threshold for aggressive behavior. Diets adjusted toward decreased protein intake (less than 18%) coupled with increased carbohydrate intake appear to exercise a mild threshold-raising influence, perhaps by enhancing serotonin-mediated impulse control and improving the brain's ability to manage stress. Recently, DeNapoli and colleagues (2000) have reported evidence suggesting that supplementation of the canine diet with tryptophan may exercise a significant modulatory effect over certain forms of aggressive behavior. In the case of dominance aggression, tryptophan supplementation of high-protein diets yielded a significant decrease in aggression scores. In the case of territorial aggression, scores were most strongly reduced in dogs that were fed a low-protein diet supplemented with tryptophan. Although this research is promising, increasing nutritional tryptophan levels may not necessarily result in an appreciable increase of serotonin production. Above a certain point, the rate-limiting factor, tryptophan hydroxylase, is saturated and unable to support further synthesis of 5-hydroxytryptophan (5-HTP)—the immediate precursor of serotonin (5-HT) (Christensen, 1996). Given the aforementioned limitation, supplementing the protocol diet with 5-HTP might have proved significantly more efficacious for enhancing serotonin production. In addition to being more directly and efficiently converted into serotonin than tryptophan, 5-HTP moves more freely through the blood-brain barrier (not needing to compete for transport molecules). Furthermore, unlike tryptophan, which remains banned from over-the-counter sale, 5-HTP is readily available and sold at health food stores (Murray, 1998)—a significant consideration if 5-HTP is ultimately shown to exert a beneficial effect on aggression problems in the dog.

Role of Integrated Compliance and Obedience Training

Most treatment programs for aggression problems incorporate some element of obedience training (Tortora, 1983; Blackshaw, 1991; Clark and Boyer, 1993; Reisner, 1997) or nonconfrontational compliance training (Line

and Voith, 1986; Campbell, 1992; Overall, 1997). According to Tortora (1983), the benefits of obedience training depend on treated dogs learning that safety can always be obtained by engaging in cooperative behavior. Similarly, Clark and Boyer (1993) have argued that obedience training promotes a "feeling of security" as the result of establishing clear lines of communication and social boundaries by selectively and consistently applying incentives and appropriate deterrents to guide and shape dog behavior. The efficacy of obedience training as a therapeutic tool has been confirmed by Blackshaw (1991), who reported a high success rate involving dominance and territorial aggression by introducing proper restraint techniques and obedience training as her primary form of behavioral intervention. Even those individuals who appear to discount the preventative value of obedience training as a *placebo,* exerting "neither positive nor negative effects on the incidence of behavior problems" (Cameron, 1997:271), may nonetheless recommend such training because "obedience training provides tools for owners to use in modifying pet behavior" (271). Finally, nonconfrontational compliance training utilizes the most simple obedience exercises (e.g., sit and sit-stay) and positive reinforcement to achieve secondary control over the expression of aggressive behavior (Voith, 1980a; Uchida et al., 1997).

Despite the apparent therapeutic efficacy of obedience and nonconfrontational compliance training, the role of such activities for the prevention of behavior problems remains controversial. Although the literature is conflicted and equivocal on the preventative value of training, many authors, nonetheless, suggest that training does appear to exert a strong preventative influence. For example, Overall (1997), an advocate of preventative compliance training, has claimed that dogs require *rules* and need a rule-based social structure to communicate and cooperate with one another and with humans, claiming that her type of compliance training (a highly intrusive variation on Voith's "nothing in life is free" program) provides a means for "preventing such problems and in treating all forms of behavioral problems" (410).

But the question remains: Does obedience or compliance training serve to prevent problems, especially aggression problems? With respect to obedience training, Voith and colleagues (1992) suggest that it may not perform a preventative function. In a study involving the analysis of 711 questionnaires filled out by dog owners visiting a veterinary hospital clinic, they found that obedience training (as well as spoiling activities and anthropomorphic attitudes) showed no significant correlation with a wide spectrum of behavior problems, including aggression. A subsequent study performed by Podberscek and Serpell (1996) also failed to show a linkage between obedience training and the incidence of aggression problems in English cocker spaniels (N = 596). Finally, in a case-controlled study involving 178 matched pairs of biting and nonbiting dogs, Gershman and colleagues (1994) failed to detect a significant statistical relationship between obedience training and the incidence of aggressive behavior.

More recently, upon analyzing the data extracted from a large sample (N = 2018), Goodloe and Borchelt (1998) reported that a preventative relationship *does* appear to exist between a history of obedience training and the occurrence of a variety behavior problems, including aggression. Obedience training was significantly correlated with a lower incidence of aggression in all categories analyzed, except aggression toward unfamiliar dogs. They also found that obedience training was generally correlated with better-behaved dogs in two complementary directions: a decrease of undesirable behavior and an increase of desirable behavior. These findings suggest that training may help guide and refine a dog's adaptation to domestic life, making it more successful and problem free. In addition to the obvious benefits of establishing limits and control, the authors suggest that the benefits of training may be related to various incidental aspects of interaction that are associated with the training process, including increased time spent with the dog, added exposure and socialization resulting from class attendance, and a better appreciation and understanding of dog behavior. This

study appears to contradict the earlier findings of Voith and colleagues (1992), which failed to identify a beneficial relationship between obedience training and the incidence of behavior problems. Goodloe and Borchelt note that the larger sample of respondents used by them may have provided a better statistical pool for detecting the beneficial influences of obedience training. They suggest that the earlier study performed by Voith and colleagues may have been too small to detect these correlations. Finally, Patronek (1996) has reported that dogs that participated in obedience classes were much less likely to be relinquished by their owners to an animal shelter.

Given the evident therapeutic value of obedience and compliance training, it is a bit astonishing that such training would not exert a more consistent and strong preventative influence over the development of aggression problems. This impasse is of considerable significance, since most treatment programs for aggression (especially dominance-related aggression) depend, in part, on some variant of obedience or compliance training. Behaviorally speaking, the treatment applied in advance (preventative training) should exert some mitigating influence over the problem, for the very same reasons that it presumably reverses it. Logically, in fact, one should expect the preventative effect to be far more robust and persuasive than the treatment effect, since the therapeutic influence must exert enough power to reverse already established aggressive behavior and prevent its reoccurrence (behavioral momentum). Further, most treatment programs are founded on the behavior-modifying effects of learning. Learning does not just occur when guided by an expert's recommendations or under the owners conscious efforts, but proceeds continuously insofar as a dog lives and interacts with its environment:

> One cannot choose to either employ or ignore the empirically established rules of learning. Much like the law of gravity, the laws of learning are always in effect. Thus, the question is not whether to use the laws of learning, but rather how to use them effectively. (Spreat and Spreat, 1982:593)

Given the apparently robust effect of behavior therapy, on the one hand, and the continuous influence of learning on the other, it is difficult to imagine how such things as obedience training, spoiling activities, and anthropomorphic attitudes would not have a significant effect on behavioral adaptation and the incidence of behavior problems.

PART 2: CHILDREN, DOGS, AND AGGRESSION

Preventing Problems

Children are often implicated in the development of serious dog behavior problems, especially those involving hyperactivity and aggressiveness. Many consultants recommend that a family not acquire a dog until the children are at least 6 or 7 years of age. This recommendation is based on a widely held assumption that children under this age lack sufficient maturity to treat a dog properly and safely. However, a child's age is not always a reliable marker of maturity. Older children may be more irresponsible and abusive toward a dog than their age would seem to indicate. In addition, younger children can be taught to interact with a canine companion safely and affectionately, often surpassing the ability of insensitive adults! Such matters depend on individual cases and on the parent's willingness to explain and demonstrate acceptable ways of behaving around a dog. In addition, the parent must provide adequate incentives and deterrents to ensure compliance by the child.

Sources of Conflict and Tension Between Children and Dogs

In the case of difficult children of any age, teasing and abusing the family dog is a prescription for disaster. Such behavior is often employed as a manipulative attention-seeking ploy and annoyance for the parent. Some older children see the dog as an easy and ever-available target for the release of pent-up frustration and redirected anger. Not surprisingly, abusive treatment of the dog often occurs after the child has been punished by parents

or by a teacher at school. In a rather bizarre and unsettling report exploring the psychosocial benefits of dog companionship for children, Bossard (1944) seriously recommends that dogs be used as ready objects for such hostile "personal needs" involving ego frustration and gratification:

> If things have gone wrong, and you feel like kicking some one, there is Waldo, waiting for you. If you have been ordered about by the boss all day, you can go home and order the dog about. If mother has made you do what you did not want to, you can now work on the dog. Long observation of children's behavior with domestic animals convinces me that this is a very important function. Often the child has been the victim of commands, "directives," shouts, orders, all day long. How soul-satisfying now to take the dog for a walk and order him about! This is a most therapeutic procedure. (411)

Recommendations like those of Bossard neglect to appreciate fully that a dog is a feeling victim, albeit silent and forbearing, until at last it is pushed to the limits of its tolerance and forced to defend itself with the familiar devastation for both the child and the dog.

Bossard also suggests that the family dog be used for sex education, arguing that "the external physical differences of sex can be seen, identified, and discussed, without hesitation or inhibition on the part of either parent or child" (411). Unfortunately, this sort of pedagogy may, in addition, facilitate abusive handling and treatment when a child is left alone to investigate and study the subject on their own. Inquisitive children may secretly offend their canine companions in forbidden ways—extracurricular activity that Bossard might have regarded as a vital and informative outlet for childhood sexual fantasies.

The incidence of such aberrant behavior among preadolescent children and the impact it has on dogs is not known. More information is available concerning the incidence of cynophilia/zoophilia among adolescent children. Kinsey and colleagues (1948, 1953) estimated that approximately 8% of the urban male population had experienced some sexual contact with an animal, whereas a surprising 40% to 50% of adolescent boys living in rural environments reported having sexual contact with domestic animals. Among adolescent urban women, 3.6% reported having sexual contact with animals, mainly (74%) involving dogs. Overall, the researchers conclude that sexual interaction between humans and dogs is relatively rare.

Children exhibiting abusive behavior toward the family dog should be referred to a child psychologist for evaluation (Ascione et al., 2000). Such activity may presage the development of more serious sadistic and violent behavior later in life. Many violent offenders abused animals as children. Also, animal-abusive children may themselves be the victims of similar abuse in the home. There are reports (Ascione et al., 2000) of findings of others indicating that pet abuse and neglect frequently present together. In one study mentioned, children exposed to sexual abuse were significantly more likely to abuse animals (27–35%) than nonabused counterparts (5%). Unfortunately, research is still lacking, but anecdotal reports and psychological case studies point to a significant relationship between child abuse and animal abuse.

Establishing Limits and Boundaries

To prevent problems, children must learn how to respectfully handle and care for their dogs. These efforts should include instruction involving appropriate and inappropriate play. Parents often assume that children instinctively know how to behave properly toward dogs. This wishful viewpoint is not always true, and some dogs are intolerant of play, just as some children are disinterested in the play of dogs. Further, children and dogs play in species-typical ways, containing movement messages that are only partially understood by each other and responded to as intended. Although significant evolutionary continuity informs the play habits of children and dogs, there are important differences in the way each initiates, interprets, and modulates their respective play activities (Rooney et al., 2000).

These fundamental behavioral differences are probably the source of many failures of children and dogs to get along together successfully. Under the guidance of a vigilant parent, both the child and the dog can learn how to play constructively with each other and avoid the risk of their playful efforts escalating

into problems. This is not always an easy process, but with perseverance and consistency the child (and the dog) can be taught to respect proper social boundaries and limits. Most importantly, the parent must be careful to set a good example for the child by avoiding inappropriate play and disciplinary efforts.

Another beneficial socializing influence on dogs and children is training. First and foremost, dogs should undergo sufficient training to establish the basic social boundaries: no jump, bite, chase, bolt, or pull. Once these boundaries are set, children can easily interact with their dogs on a friendly level and reinforce cooperative behavior with affection, food, and toys. Children should participate in the training process and practice with their dogs on a daily basis. Rewards of all kinds can be used by children to gain a surprising degree of control over their dogs. The primary benefit of such training is the provision of a foundation for effective interaction between the children and dogs based on enhanced communication, cooperation, compliance, and compromise. In addition, according to Levinson (1980), many subtle psychological benefits may be obtained by allowing children to participate in training activities:

> Part of acquiring autonomy is the taking over of control of one's behavior, the development of self-disciplining and impulse control. The ability to delay gratification, to exercise patience, to carry out responsibilities, to recognize and defer to the needs of others on occasion are all part of being a self directing human being. A child who is responsible for the well-being and training of a pet has to exhibit all these capacities. He is also trying to inculcate some of the abilities in his pet, who must wait to be fed or walked, will not always be played with on demand, must learn not to damage furnishings, etc. Of course, the more self-mastery the child has acquired the better he can train his pet, but the very act of trying to train his pet successfully will reinforce self-control to some extent. . . . Through trial and error in teaching his pet new tricks, the child discovers that he must at times control the frustration he feels when his pet is not learning as quickly as he would like. Through bitter experience he learns that scolding and punishment will only serve to delay or impede the pet's learning. As the child develops more tolerance for his pet's difficulties, he may become more tolerant of his own inability to master his lessons, less inclined to view himself as "stupid" or "bad." (69)

Even under the most favorable circumstances, children may be tempted to test limits with their canine companions. Such interaction might actually help children to build an empathetic appreciation of how their behavior impacts on others. Optimally, the dog offers itself as a living being with which the child can explore and *test* the effects of affectionate and caring treatment. However, even innocent behaviors like hugging and holding may be interpreted by a dog as threatening gestures, particularly while it is sleeping or eating (Voith, 1981). Teaching children not to disturb dogs engaged in these activities goes some way toward preventing unnecessary dog-bite incidents. Also, whenever possible, conscientious efforts should be made to decrease the amount of screaming and rushing around the dog. In the case of busy households, an open crate can be provided to the dog as a haven of security within the otherwise chaotic maelstrom of household activities.

In addition to training, children should be taught to avoid engaging dogs in improper and provocative play like roughhousing, chase-and-evade jousts, and inappropriate tug-of-war games. Exposing dogs to daily agitational play and excessive teasing may result in the development of adjustment problems, especially competitive excesses and hyperactivity. Children constantly teasing, screaming, and running wildly through the house are bound to unnerve even the most calm and docile dog. Such behavior on the child's part increases the dog's irritability while simultaneously lowering his threshold for aggression. Consulting trainers should draw attention to the dangers of such "play" and candidly suggest to owners ways of teaching their children better ways of behaving around dogs. Ideally, parent-owners should patiently guide children by explaining how such behavior adversely affects dogs. Children should be instructed to leave sleeping and eating dogs alone and not to tease them with toys or disturb them when they possess one. On the positive side, children should be taught alternative games like ball play and hide 'n seek. Finally, children should be explicitly taught how to touch and handle dogs properly in a calming and reassuring manner.

DOG AND BABY

A common reason for dog owners to seek professional advice is to learn how to introduce a baby *safely* into a household with a resident dog. Expectant parents seeking such information are often concerned about how the dog might react to the presence of an infant, but they are often especially apprehensive about the possibility that the dog might actually bite or otherwise injure the child. These fears may be based on unfounded worries or express legitimate concerns about the dog's behavior, based on previous overt displays of aggression toward family members, guests, or other animals. Even in those cases where no evidence of previous aggression exists, the expectant parent may still harbor reasonable fears about their dog's potential behavior toward the baby, based on more subtle behavioral signs and temperament traits.

Of course, the worst secret fear is that the dog might actually attack or kill the infant. Although this is a remote possibility, fatal dog attacks on babies are statistically rare and very unlikely if the owner takes the most basic precautions. Unfortunately, there exists an irrational and widespread exaggeration of the risks involved, making some owners unnecessarily fearful about the possibility of an aggressive incident. This perception may be a by-product of the way in which periodic serious or fatal dog attacks are handled by the news media. The occurrence of such horrifying incidents receive inordinate (and often irresponsible) national and international coverage. Such reports are shocking to the public. The dog is a cultural symbol of devotion, fidelity, and protection and, when a fatal attack occurs, it strikes a deep and discordant chord of curiosity and horror. It is not difficult to understand how such reports stimulate unnecessary foreboding about the family dog's reaction to the arrival of a new baby. Regrettably, the result of such misunderstanding is often the unnecessary relinquishment of a healthy and friendly dog to an animal shelter, thereby exposing it to a potentially tragic and unjustifiable fate.

Recognizing that such apprehensions probably exist (unconsciously or consciously) in the minds of many parents, dog behavior counselors should allay or dispel such fears by explaining that dogs rarely attack or kill babies. Nonetheless, commonsense precautions should be taken to make the transition an easy and uneventful one for both the dog and the infant. Although most dogs represent a minimal risk to infant children and ultimately make suitable companions, some dogs are simply too dangerous to be in close contact with young children and should be placed into a home without children. Many owners express fears that the dog will resent the baby, perhaps *acting out* toward the infant as the result of sibling rivalry or jealousy. These owners need to be reassured that the dog is not likely to behave aggressively toward the infant as the result of jealously, but excessive *rivalry* for the owner's attention may increase the risk of problems arising as the result of competition for the owner's attention and contact. Although the vast majority of dogs are not likely to attack or otherwise hurt a baby, a dog does represent some degree of risk to a helpless infant and, therefore, should be evaluated and receive sufficient training *before* the baby comes into the home, rather than waiting until problems arise. These situations are often very complicated and should receive the utmost care and professional attention.

EVALUATING THE RISK

The average dog owner is often unable to assess objectively their dog's potential threat to the infant. Consequently, an important service rendered by dog behavior consultants is to provide an assessment of the various risks involved and to advise owners on how to minimize them. This can be a very uncomfortable and onerous responsibility, since a number of serious decisions have to be made that may dramatically affect a dog's future, based largely on a consultant's findings and recommendations. Furthermore, although many risk factors have been identified (Voith, 1984; Wright, 1985; Riegger and Guntzelman, 1990; Mathews and Lattal, 1994), no evaluation procedure currently exists that provides a *certain* determination of risk. Ultimately, such assessments rely on available scientific information, a history of aggressive behavior, and, most importantly, *gut* feelings about the dog and the situation.

The telephone interview provides valuable information about the dog and the family situation. An important goal of the initial interview is to develop a preliminary risk assessment of the immediate danger of bringing an infant into the home. The information obtained should include (at least) the following: the dog's sex and status, age, breed or mix, general activity level, training history, past socialization with children, evidence of predatory behavior toward small animals, history (e.g., place, frequency, and persons involved) of aggressive behavior toward people, type of aggression involved (e.g., dominance related, fear related, predatory), and history (e.g., place, frequency, and dogs involved) of aggressive behavior toward other dogs. Initial findings like these provide a risk profile based on salient behavioral, physical, and temperament factors.

The following profiles exemplify the opposing directions of high risk and low risk:

High-risk profile: A 2-year-old male (intact) dog with minimal previous contact with children. When exposed to children, the dog exhibits signs of increased irritability and nervousness. The dog has not received significant training, bolts out of control if given a chance, guards (growls and snaps) over food and toys, threatens guests (must be leashed for their protection), and has a history of chasing and killing small animals.

Low-risk profile: A 1½-year-old female (spayed) with a gentle disposition toward children with whom she has had steady contact. The dog attended puppy classes and has received 10 weeks of obedience training, she is playful and affectionate toward people and other dogs, enjoys ball play and brings the ball back, exhibits an enthusiastic greeting toward everyone (animals and humans alike), and never guards food or toys.

Obviously, most family dogs fall somewhere between these two extreme profiles, with a few exceptional dogs situated above and below them. Although the hypothetical dog profiled in the high-risk category has never actually bitten anyone, he still represents a serious potential threat to a baby. Generally, rather than tolerate the dangers posed by a dog with a high-risk profile, the owner is advised to rehome the dog and to consult further with their veterinarian about other courses of action to consider. Clearly, anticipating such problems and rehoming the high-risk dog into a home without children would be preferable to waiting until a definitive incident occurs, perhaps leaving only one recourse available—euthanasia.

In such cases, astute counselors make it a practice to error on the side of safety and caution, rather than to make a grave mistake that could result in serious injuries and catastrophic consequences for the victim and the trainer alike, potentially including very serious legal and professional repercussions. Unfortunately, the behavioral risk presented by high-risk dogs to children may not be significantly alleviated by the most conscientious and intensive training efforts. Again, rather than waiting until it is too late, it is far better for all involved to rehome high-risk dogs and to discourage their owners from pursuing behavior modification and training. In addition to the risk factors listed in Table 6.3, some dogs may become progressively irritable and intolerant of contact as they grow older, either as the result of physical disease and discomfort or due to geriatric cognitive deficits. Interestingly, female dogs are twice as likely as males to exhibit geriatric or *late onset* aggressiveness (Hart and Hart, 1997). Also, according to this research, male dogs are more likely to become less aggressive as they age than are female counterparts.

In addition to evaluating the dog, it is important to consider the family situation, as well. This is particularly important in *borderline* cases where a successful transition will depend on the family's ability to faithfully carry out the various instructions provided to them. One especially problematic situation involves families that are divided about the dog's continued residency in the home. In such cases, one owner may be very fond of the dog and willing to assume the full responsibility for its training, but the other spouse may be overtly hostile toward the idea or secretly harbor serious misgivings and actually prefer that the dog be rehomed or euthanized. The reluctant partner might even go along with the idea of training the dog, often to

TABLE 6.3. Significant risk factors for aggression toward children

Lack of significant obedience training, especially in highly active, controlling, or independent dogs that resist efforts to control them.
Little or no significant socialization with children, especially if combined with evidence of fear or past aggression toward children.
Possession-related aggression over food, toys, and places.
Overly sensitive to touch or exhibit obvious signs of fear when approached with outstretched hands.
Fearful and slow to adapt to new situations, especially if the dog becomes avoidant or aggressive toward nonthreatening contact with children.
A history of preying on small animals, especially if it includes killing after the chase.
History of dominance-related aggression, especially in cases where the dog exhibits aggression when awakened from sleep.
Dogs that react to minimal frustration with aggression.
Dogs kept outdoors or chained most of the time.

placate the determined spouse defending the dog. When all is said and done, though, he or she may refuse to recognize the dog's progress, ultimately demanding that the dog leave despite good progress. This is a no-win situation that can be detected and avoided by a skillful counselor during the initial interview with the family.

The natural and easy way that dogs and children appear to get along may produce a perilous misunderstanding and complacency about the risks involved when introducing a newborn infant to the resident dog. As a result of this unwise perception, the infant may be put at great risk by being brought home and presented to the dog without much advance preparation to make the transition more safe and uneventful. On the other extreme, some dog owners are irrationally fearful of what the dog might do to the newborn child, even though it has never exhibited any real evidence of being a significant risk. Instead of working with the dog, they simply remove the "threat" from the home.

PREVENTING BITES

The child and dog have enjoyed an age-old comradeship. While reading W. Fowler Bucke's (1903) study of children's attitudes toward dogs, one is struck by the perennial and universal way children perceive and appreciate dogs. Unfortunately, children do not always interpret correctly the risks involved. Many situations involving bites are obviously evoked by children by placing dogs under some form of physical or mental duress. One of Bucke's young correspondents wrote,

> During the summer he had sore ears. One day I was playing near the door. Mother had just said, "Be careful, do not pull Bowler's sore ears." I did not heed mother's word, but went on climbing up his back by holding on to his ears. The poor dog endured the pain as long as he could, and suddenly snapped at me, biting my lower lip. When the doctor came I was lying on the sofa near the window. The dog came and looked in the window, and gave a pitiful whine, and for several days went about with his head down, and his tail between his legs. I begged father not to kill him, as he threatened to do. (493)

Many attacks delivered by family dogs upon children are produced by similar causes; that is, the dog bites only under provocative and easily avoidable circumstances. The bites involved are typically well directed and inhibited, occurring once, and have a self-protective character and purpose. Dogs that undergo daily abuse at the hands of their *own* child companions may be incredibly forbearing and may never attempt to bite *them,* but, woe, let another child enter the house unexpectedly or approach the dog in a startling way, and a very serious attack may occur.

How can dog bites be prevented? An adequate answer to this question involves addressing at least three equally important areas:

1. Educate the child about the dangers of mistreatment and teach him or her how to interact appropriately with the family dog and other dogs.
2. Provide the dog with adequate training and socialization around children and strangers.
3. Reward breeding efforts that emphasize temperament and intelligence over good looks.

One of the most frequently cited causes for the apparent increase in aggressive behavior in recent years is the dog world's favorite whipping boy and black sheep—the *puppy mill.* Although a convenient and worthy target of blame for some of the modern dog's plight, the puppy-mill hypothesis can hardly account for all of the dog's problems. Dogs acquired from pet stores represent only a small fraction of the total dog population, with approximately 7% of all dogs registered by the American Kennel Club being obtained through that venue (Shook, 1992).

As destructive as the puppy-mill situation is, it can hardly shoulder all of the blame for the alleged degeneracy afflicting purebred dogs (Lemonick, 1994). Other equally unscrupulous breeding practices for show and profit have also played their part. Although dogs acquired from pet stores often have behavior problems, their contribution to the aggression problem is eclipsed by dogs derived from other sources, including those bought from professional and hobbyist breeders. Reisner and colleagues (1994) at Cornell University, for example, found that dogs purchased from pet stores represent only 9% of the total number of dogs with serious dominance-related aggression problems. On the other hand, dogs bred by breeders constituted 68% (professional, 24%; and hobbyists, 44%) of the 109 cases of dominance aggression presented for treatment.

Aggressive behavior is influenced by an amalgam of acquired and biological factors. Consequently, if the problem of dog aggression is to be addressed, it will take a cooperative effort consisting of responsible breeding, competent training, and education. Responsible breeders can begin by placing an equal or greater emphasis on temperament and function, rather than focusing too much attention on form and good looks. Also, breeding should encourage traits conducive to harmonious family life, rather than perpetuating traditional and obsolete functions that have lost their usefulness. Finally, in addition to sound breeding practices, a dog's innate potential can be fully actualized only by the beneficial influence of early and lifelong training, aimed at perfecting the dog's social and domestic adaptation to modern circumstances and demands.

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7

Intraspecific and Territorial Aggression

Lo, when two dogs are fighting in the streets,
With a third dog one of the two dogs meets;
With angry teeth he bites him to the bone,
And this dog smarts for what that dog has done.

HENRY FIELDING, *TOM THUMB THE GREAT* (1918)

PART 1: INTRASPECIFIC AGGRESSION

Competitive interaction between dogs results from a variety of complex social and territorial interests. Many of the same issues affecting aggression toward humans (interspecific) also affect aggression exhibited between dogs (intraspecific). But, unlike interspecific threats and attacks, intraspecific aggression also appears to be motivated to some extent by sexual-reproductive imperatives. Dog fighting

occurs under two broad circumstances: (1) between dogs not sharing the same household (nonresident directed) and (2) between dogs sharing the same home (resident directed). Most interdog aggression takes place between dogs of the same sex.

ETIOLOGY AND ASSESSMENT

Fighting is common among dogs and often results in serious and expensive injuries to combatants and to people, who are frequently bitten while attempting to separate gnashing and thrashing antagonists. The behavior is particularly prevalent among male dogs, but female dogs may also become determined fighters, especially females that live together in the same household. Urban dogs appear to be relatively more likely to develop a fighting problem, with most dog fights occurring between dogs walked off-leash in the late afternoon or night (Roll and Unshelm, 1997). The higher incidence of fighting among this particular population of dogs may occur because of the close daily contact they have while being walked on narrow sidewalks or exercised together in city parks. For obvious reasons, the powerful working breeds, especially shepherding dogs, are most commonly involved in fights that result in injuries requiring veterinary attention, but severe fighting is certainly not limited to such breeds. Intraspecific intolerance is recognized as a typical feature of terrier-type breeds (Scott and Fuller, 1965). Sherman and colleagues (1996) found that terriers presented disproportionately with fighting problems but only with respect to nonresident targets. Also, male and female dogs appear to differentiate in terms of the context and targets of intraspecific aggression. The majority of nonresident-directed aggressive episodes involve unfamiliar intact-male dogs obtained from breeders (Roll and Unshelm, 1997), whereas most resident-directed aggression involves spayed-female combatants (Sherman et al., 1996).

Many factors influence the development of intraspecific aggression. Determining the targets and the exact situations where fighting breaks out is useful information. Does a dog exhibit aggression toward all dogs regardless of their sex or status (castrated/spayed)? Does a dog exclusively fight with members of the same sex? In the case of dogs that live together, does fighting ever occur in the owner's absence? Is fighting more likely to break out in the presence of any particular family member? Answers to questions like these and others are extremely useful for properly evaluating the problem and helping to select the most appropriate course of training and behavior modification. Dogs fight with one another for many different reasons. Although dogs may be biologically inclined to exhibit such behavior, the effects of early socialization, traumatic events involving other dogs, and a dog's history of fighting should be carefully assessed. This is especially significant when evaluating aggression that is highly generalized and targeted against both male and female dogs, regardless of context.

OWNER CHARACTERISTICS OF *AGGRESSORS* AND *VICTIMS*

Roll and Unshelm (1997), who collected and analyzed questionnaire information from dog owners (N = 206) seeking emergency treatment after a dog fight, found clear differences among the owners of aggressors (N = 55) versus the owners of victims (N = 151). Unfortunately, the authors neglected to interpret their findings (see Table 7.1), and it is difficult to see how they might influence the development of interdog aggression. In practice, many owners of aggressors are in active denial with respect to their dog's behavior, often refusing to come to grips with what the dog is doing. They are prone to engage in diverse and capricious interpretations of their dog's aggressiveness in order to avoid the painful recognition that their beloved dog is a public threat and menace. Frequently, their explanations take the form of irrational justifications and rationalizations designed to mitigate the seriousness of the dog's behavior, to make excuses for it, or to lessen the dog's culpability and, perhaps, their own responsibility for it (Sanders, 1999). Other owners may be indifferent or exhibit an unusual degree of tolerance for such behavior. Some may condone the behavior or hesitate to correct it, fearing that such efforts might inadvertently suppress more desirable protective tendencies. These

TABLE 7.1. Owner characteristics of aggressors and victims

Owners of aggressors
Mostly males who were self-employed or academics aged between 30 and 39 years.
They tend not to form emotional relationships with their dogs and often report having owned dogs for most of their lives.
They consciously select specific breeds and show interest in protection training (Schutzhund).
They tend to obtain dogs for security reasons.
Dogs are often trained through physical force.
During the fight itself, owners of the aggressor may react impassively and shout at the dog only after the fight has come to an end. Many of these owners (40%) show no reaction at all, during or after the fight.
Owners of victims
Many owners of victims are women who are housewives or pensioners.
They often keep dogs for the prevention of loneliness and safety.
They do not tend to select their dogs on the basis of breed considerations.
Dogs are trained by less forceful means.
Fewer owners of victims report having owned dogs most of their lives than reported by owners of aggressors.
Owners of victims will often attempt to console their injured dog after a fight.

After Roll and Unshelm (1997).

concerns are not necessarily allayed by explaining that protective aggression and dog fighting are not necessarily linked with each other; in fact, dog-aggressive dogs are usually surprisingly friendly and outgoing toward people. Finally, a special case exists in which the owner secretly takes pride in the dog's dangerous behavior. Such owners appear to project their own aggressive fantasies and insecurities vicariously upon their dog, thereby exploiting and victimizing all involved for the sake of their own perverse and cowardly pleasures.

DOMESTICATION AND DEVELOPMENTAL FACTORS

Phylogenic Influences

The tendency to fight is a phylogenetic or species-typical trait. The tendency predisposes many dogs to engage other dogs of the same sex in agonistic contests, primarily involving ritualized displays and assertions of dominance. In general, however, the trend among the majority of domestic dogs is in the direction of exhibiting maximum tolerance and minimum aggression when interacting with conspecifics. Over many centuries of domestication and selective breeding, the dog's physical structure, physiology, and behavior have undergone dramatic transformations, resulting in a significant biological divergence from the ancestral prototype on many levels (Frank and Frank, 1982). The dog's appearance and behavior have been strongly influenced by a pervasive process of neoteny, causing it to remain more puppylike as an adult than the wolf. Neoteny has also disrupted the normal developmental expression of various instinctive behavioral and communication systems. Relevant to the present discussion is the finding that these neotenous changes in the dog's appearance may impede its ability to express and receive unambiguous threat and appeasement displays (Goodwin et al., 1997). Besides making dogs appear more puppylike, neotenic changes appear to have elevated fear and aggression thresholds in dogs while simultaneously lowering the threshold for affiliative behavior and play. In most well-socialized dogs, close friendly bonds and playful interaction overshadow and restrain the expression of fear and aggression (Bradshaw and Lea, 1992).

Despite these general trends among the majority of dog breeds, some guard and fighting breeds may have undergone specific genetic changes that cause them to respond abnormally to conspecific agonistic threat and appeasement displays (Lockwood and Rindy,

1987). In such dogs, genetically lowered thresholds for overt damaging attacks appear to take priority over ritualized aggressive contests. Also, guard-type and fighting breeds may have undergone genetic alterations enabling them to tolerate pain at more intense levels of stimulation than the average dog—all factors contributing to their aggressive tenacity and *gameness.* Besides hardness of bite, such breeds often exhibit a notorious unwillingness to let go once the bite is secured, sometimes requiring extreme measures to get them to release their hold (Clifford et al., 1983).

Ontogenic Influences

Playful competition can be observed in young puppies shortly after they enter into the socialization period around week 3 (see *Learning to Relate and Communicate* in Volume 1, Chapter 2). These agonistic activities escalate over the ensuing weeks until much of the interaction between puppies is devoted to aggressive play and sparring. Some litters are more aggressive than others, but all healthy puppies play aggressively with one another. A possible purpose underlying early aggressive contests is the establishment of a hierarchically stratified group, resembling in many important respects an adult pack. While establishing relative dominance among littermates appears to be an important function of aggressive play, it also appears to be done for its own sake, that is, for the sheer physical exertion and pleasure of it. As puppies develop, the intensity of their fighting may escalate and involve more than two playful combatants, with puppies aligning themselves cooperatively in order to outnumber and subdue an opponent. Occasionally, the lowest-ranking puppy is at risk of receiving excessive mobbing by the rest of the group and may need to be removed to avoid injury or emotional trauma (Scott and Fuller, 1965).

HORMONAL INFLUENCES

Hormonal activity appears to influence the expression of intraspecific aggression (see *Hormones and Aggressive Behavior* in Chapter 6). Intact males are the most common aggressors and targets of attack (Roll and Unshelm, 1997). An androgen surge in the male dog during the adolescent period between months 6 and 8 (Hart, 1985) may exert a pronounced influence on behavioral thresholds regulating aggressive behavior between dogs. These hormonal changes are frequently associated with the simultaneous appearance of heightened intermale aggressiveness and urine-marking activities. Adult males appear to be particularly intolerant and hostile toward other intact males coming into puberty. Such aggressive challenges and frisks do not usually escalate to the scale of damaging fights, but this rule is definitely not always the case, since not all adolescents subordinate themselves without offering a contest. This increased aggressive interest and targeting of intact adolescents may be under the influence of olfactory pheromonal cues and the often taunting and *uppity* behavior shown by adolescent dogs. Not only are adolescent intact males more attractive as targets, they themselves are much more provocative than castrated counterparts or females. Castrated dogs, in contrast, belonging to this age group are far less likely to attract the aggressive interests of mature intact dogs. In general, castrated dogs appear to be less aggressive toward other male dogs and more apt to submit, rather than fight back, when challenged. Male dogs rarely direct their aggression toward females, except in cases in which the female attacks first. And, even then, the resulting skirmish is often more a picture of confused self-defense than fierce fighting.

Castration and Dog Fighting

Since there appears to be a clear correlation between the development of intermale aggression and adolescent hormonal activity, a preventative measure that ought to be considered is early castration. Hopkins and colleagues (1976) found that 63% of dogs showing intermale aggression exhibited either a rapid decline (38%) or a gradual decline (25%) of fighting activity after castration. More recently, Neilson and coworkers (1997) reported,

> With regard to aggression toward other canine or human members of the family, approximately 25% of dogs can be expected to have a

> 50 to 90% level of improvement after castration. A comparable reduction in aggression toward unfamiliar dogs or human territorial intruders can be expected in 10 to 15% of dogs after castration. (182)

For optimal preventative effects, the surgery should be carried out sometime between months 5 and 6, although the benefits of castration on such behavior do not depend on a dog's age at the time castration or the duration of the problem. Some evidence suggests that castration performed between weeks 8 and 12 may produce even more pronounced effects (Lieberman, 1987), but the actual benefits of early castration remain controversial. However, this option may be seriously considered in the case of individuals belonging to breeds prone to dog fighting. It must be emphasized, however, that even early castration will not necessarily prevent the development of dog fighting. Many individuals that have undergone preadolescent castration still exhibit strong intermale aggressive tendencies. This effect may be due to perinatal androgenization occurring just before and after birth.

Urine Marking and Intermale Aggression

Although a causal relation between urine-marking behavior and territorial aggression has not been definitively established in dogs (see below), some authorities strongly believe that such a causal relation probably exists. The assumption that urine marking is a causal precursor of territorial aggression has resulted in treatment programs in which dog owners are instructed to discourage their dogs from urine marking away from the home, especially in cases involving interdog aggression (Campbell, 1974; Juarbe-Diaz, 1997). Apparently, following Campbell's logic (although not citing him as her source of information), Juarbe-Diaz (1997) suggests that a major motivation of nonhousehold intermale aggression is the defense of urine-marked territories. Along with Campbell, she recommends constraining such aggressors from eliminating away from the home *territory,* "because this is believed to extend their territory beyond the boundaries of their owner's property" (504). This treatment program is of questionable value, not only because there is no credible evidence showing that it actually works, but, more importantly, because such restriction is highly intrusive and very difficult to implement. Further, simply because urine marking and intermale aggression appear to occur together in the same dog is not proof that the one habit is causally related to the other or that restricting the one activity will significantly limit the expression of the other. If such a causal link exists, dogs isolated to yards and rarely walked should be much less aggressive toward conspecifics than dogs walked and allowed to urinate freely; this has not been proven to my knowledge. Lastly, Hopkins and coworkers (1976) found no effect of castration on territorial aggression, even though castration exerted a pronounced effect on marking behavior. Other relevant studies have shown only a very slight benefit from castration on aggression related to territorial defense [see Neilson et al. (1997)]. Although increased urine marking and intermale aggression may share a common source of causality at some level of functional organization [see *Arginine-Vasopressin (AVP) and Aggression* in Volume 1, Chapter 3], the frustrative inhibition of one habit will not likely help to suppress the other; on the contrary, such efforts might actually potentiate it, thereby making matters worse. A major source of concern with the recommendation is that the abrupt restriction of urine-marking activity may instigate iatrogenic elimination problems, such as marking inside the house. Finally, urine marking is a normal canine activity that appears to represent a significant source of pleasure and excitement for dogs and, unless significant evidence is made available to support the notion that its restriction can significantly aid in the control of interdog aggression, it would seem advisable to let dogs urinate where they sniff fit to do so—as long as it is done outside of the house.

Socialization and Aggression

An important factor in the development of intraspecific aggression is the quality and quantity of early socialization. Puppies taken too early from the litter (before week 6) may become socially intolerant toward other dogs as adults. Even in cases in which puppies are

removed from the litter at an optimal time for secondary socialization with people (e.g., around week 7 or 8), the social learning needed to interact confidently with other dogs is not complete. Subsequent to adoption, the average puppy is only infrequently exposed to other dogs, perhaps further compromising the social skills needed for peaceful interaction. Roll and Unshelm (1997) report that nearly half of the aggressors and victims in their study were described as having few interactions with conspecifics between the ages of 5 weeks to 5 months. Such socialization deficits can be ameliorated by exposing a young puppy to other dogs of its age group through various activities like puppy kindergarten or play groups.

Even when a puppy remains with the litter throughout the socialization period, the experience itself may predispose it in various ways to react aggressively toward other dogs as an adult, especially unfamiliar dogs perceived as not belonging to its social group. This is particularly true in the case of puppies situated on either extreme of the dominance hierarchy. An *omega* subordinate, having undergone excessive or traumatic badgering by higher-ranking littermates, may consequently become progressively agitated and defensive toward other dogs. Such puppies can be surprisingly difficult to handle and train because of their sharpened reactivity to close social contact. As a result of their early experiences, they may become conditioned to react defensively when approached or touched. On the other hand, an *alpha* puppy may be influenced adversely by an opposite set of early social experiences, especially the successes it experienced while threatening and subordinating littermates. As an adult, the *alpha* puppy may be more prone to exhibit intolerance toward male conspecifics and actions perceived as *status* threats. Socially controlling or *dominant* puppies have been socialized to be aggressive and unyielding—early learning that often must be countered with remedial training. The most socially adaptable puppies are those that fall somewhere in the middle of the dominance hierarchy. Such puppies know how to assert themselves effectively and to occupy dominant roles or, conversely, they can submit and play subordinate roles when it is in their best interest to do so.

Early Trauma and Fighting

Many fighting problems stem from unpredicted attacks perpetrated by strange dogs. Although most adult dogs are gentle toward young puppies, some are not so inclined and may trounce defenseless youngsters, sometimes causing a lasting fearful psychological impression, making the victims wary of such contacts in the future. Such experiences appear to underlie the later development of some forms of intraspecific aggression. Puppies exposed to such attacks are susceptible to develop a prejudice against other dogs belonging to the aggressor's breed type or generalize more broadly in terms of the aggressor's size and color or simply learn to react defensively to all unfamiliar dogs. Many owners report a single surprise attack as the sole precipitating cause of their dog's fighting problem. Affected dogs appear to strike preemptively in an effort to assume the defensive advantage of a forceful offense. Such dogs, affected by the belief that they cannot predict when an attack might occur, may become increasingly vigilant and treat every encounter as though it represented a serious threat.

Territorial Agitation

Some dogs have developed intense aggressive attitudes toward other dogs as the result of territorial intrusion or violation. This is especially the case in dogs restrained on a chain and stake or kept behind fencing exposed to passing dogs. Dog fighting along fence lines is a common problem. Both males and females engage in this behavior, but it is a particular favorite of intact males, especially when the target is another male dog. The fence line is very problematic when it is shared with a neighboring dog, since it simultaneously demarcates the *intruder's* territorial boundary as well as the defender's. In nature, such situations rarely, if ever, develop. Territory is safely ensconced deep within a home range that is regularly inspected for intrusion. Under natural conditions, distant scent marking and various remote activities such as vocalizations and obvious evidence of pack residency like past kills and fecal deposits serve to ward off all but the most persistent intruders. Such terri-

torial devices serve to prevent inadvertent territorial overlapping between neighboring animals and, thereby, prevent unnecessary intergroup agitation, competition, and the potential for dangerous fighting.

Under domestic conditions, these territorial mechanisms are frequently ignored or violated, leading to heightened reactivity and the constant threat of serious attacks. In the case of fence fighting, intense aggression is frequently seen because both dogs claim the same boundary as their own. Since nothing is ever resolved one way or the other and both remain protected from each other, fighting escalates and becomes ritualized, frustrative, and very persistent. Many fence fighters develop various compulsive weaving, whirling, and fence-running habits. Although dogs have broken teeth on chain-link fencing and experienced other superficial injuries as the result of such fighting, the real problem involves kindling effects and the fostering of more general aggressive reactivity and aggressive biasing toward other dogs.

The agitation of daily fence fighting and the heightened aggressive arousal associated with it stress dogs, as well as facilitate the development of various undesirable behaviors: hypervigilance, hyperactivity, frustrative oral and somatic activities (chewing and digging at fence lines), and excessive barking. In addition, such unrestrained behavior is at risk of being redirected toward nearby people or dogs. When more than one dog is defending a fence line against intrusion, the situation can easily escalate into an outbreak of fighting between erstwhile defenders. Furthermore, unchecked aggressiveness near fence lines may inadvertently encourage dogs to become aggressive toward children and others walking nearby. The influence of fence fighting on territorial defense is discussed in greater detail in Part 2 of this chapter (see *Sources of Territorial Agitation: Fences and Chains*).

Virago Syndrome

While fighting behavior problems are most typically associated with male dogs, female dogs may also engage other dogs (male and female) in aggressive contests. This is especially the case with females living together in the same home. Females tend to establish a separate dominance hierarchy from that of males. Interfemale aggression is often intense and frequently involves injury. Causal factors appear to involve reproductive rights and privileges of dominance. Among wolves, only the alpha female is permitted to procreate. The alpha female appears to protect this privilege by hounding and harassing other mature females. This bickering and agitation appears to psychologically stress potential rivals, thus preventing them from entering a receptive and fertile estrus (see *Stress Hormones and Aggression* in Chapter 6). At such times as these, intense conflicts may flare up and grow into overt and damaging dominance fights. This pattern of birth control does not always work, however. In those cases where a subordinate interloper mates successfully, the punishment may be severe—her death. Wolves rarely fight to the death, but this is one situation where such fighting has been observed at least among captive wolves (e.g., Wolf Park, Battle Ground, Indiana). Breeders should be careful when breeding a subordinate female that lives in a situation with a more dominant female.

Aggression Between Opposite Sexes

Although resident-directed aggression between opposite-sex combatants is less common, when it does occur females are twice as likely to initiate attacks against male dogs than male dogs are to initiate attacks against females (Sherman et al., 1996). The mildest form of such fighting occurs when an unreceptive female rebuffs the advances of an unwanted suitor. The male usually accepts the rejection without retaliation, although he may persist in his seductive adventures until more fully convinced of her sincerity. Occasionally, however, a male may answer in kind, sparking a more serious battle of wills that may escalate into serious fighting. Another source of intersexual agonistic behavior can be observed when two puppies of the opposite sex are raised together. Although larger and, perhaps, more aggressive in general terms, the male is often pitifully subordinated by the relentless harrying of the more dominant female. The inclination for females to attack or excessively

dominate conspecific males is here referred to as the *virago syndrome.* As an adult, a viraginous female may engage the opposite sex in earnest fighting but not to the exclusion of members of her own sex, which she will also readily fight. This is a somewhat disconcerting situation for a male that does not recognize the female as a target for aggression and may be nonplused by her intentions. As a result, many males halfheartedly defend themselves, give ground, fumble over themselves, and simply retreat if they can. Such safe and successful consequences may be very reinforcing for a victorious female, encouraging her to instigate other aggressive challenges when encountering male dogs. Although many males do give ground, even very dominant males that would readily fight if it were another male making such trouble, she will eventually encounter a male that will not back down, with great potential for a serious and damaging fight.

Few unlimited generalities can be made about virago females other than their tendency to fight male dogs. Many are somewhat larger than others of their breed, and they often have a masculine appearance, exhibit some malelike behavior patterns, and are frequently aggressive in other ways besides dog fighting, including aggressive behavior exhibited toward people. Virago females urinate more frequently than is usually the female's custom, sometimes raising their leg in an effort to squirt onto vertical surfaces.

Perinatal Androgenization

One potential etiological basis for the development of the virago syndrome and other forms of heightened intraspecific aggression in females may stem from prenatal influences brought about by vagrant testosterone in amniotic fluids. Strong experimental evidence suggests that female embryos situated between males in the uterus are more likely to develop malelike aggressive tendencies and scent-marking patterns than are counterparts otherwise situated. Although this effect has not been directly demonstrated in dogs, it has been observed experimentally in mice and guinea pigs (Knol and Egberink-Alink, 1989). Some suggestive evidence regarding the effects of perinatal androgenization of female dogs has been reported by Coppola [1986—see Borchelt and Voith (1996)]. Among 14 female dogs presenting with dominance aggression and an increase of malelike behavior after spaying, he found that female aggressors were more likely to have been from litters predominantly composed of male puppies. Supportive evidence for this hypothesis has been reported by Beach and colleagues (1982), who exposed female dogs to testosterone prenatally and postnatally in an effort to determine the long-term effects of early androgenization on adult agonistic behavior. The researchers subsequently tested the androgenized or *pseudohermaphroditic* females for relative dominance ranking in dyadic pairings with adult intact males and spayed females. The paired dogs competed against one another for access and control of a bone. When male dogs were paired with spayed females, the former controlled the bone in 78 of 100 encounters. The androgenized females were similarly effective against spayed females, controlling the bone in 70 of 100 encounters but were only 39% of the time successful against intact males. When the androgenized females were already in possession of the bone and then challenged, they did not fare much better than spayed females against the males' effort to expropriate the prize. One significant difference did emerge, however: the androgenized females were much more aggressive, threatening males in 78% of the encounters compared to 20% of the time by spayed females:

> Males were threatened by P [pseudohermaphroditic] possessors in 78% of the tests compared with 20% for the F [spayed females] possessors. In 12 of 61 tests, a P possessor and a M challenger fought vigorously, but in all instances the M emerged as victor. . .. The aggressive behavior of P possessors was maladaptive in that it did not constitute successful defense. Although they always lost the bone, several Ps engaged in fights repeatedly. This was the outcome of strong reluctance to yield possession and a heightened tendency toward contentious behavior. (873)

Clearly, perinatal exposure to testosterone enhanced the pseudohermaphroditic females' dominance ranking over spayed females but not toward intact males. The observation by

Beach and colleagues that androgenized females are more aggressive and ready to fight maladaptively is of some significance to the role of testosterone in the expression of competitive aggression. Incidentally, androgenized females eliminate in the familiar raised-leg fashion of male dogs.

Aggression Between Dogs Sharing the Same Household

The majority of aggressive episodes involving dogs sharing the same residence are initiated by the youngest and most recently obtained member of the group. Statistically, as already mentioned, females are more likely than males to fight with one another when living in the same household. Also, aggression between resident dogs frequently results in more serious injuries to the combatants than observed in the case of nonresident fighting (Sherman et al., 1996).

In domestic situations involving two or more dogs, ritualized fighting is a common occurrence. This is especially the case where the dogs are of the same sex. Three basic forms of aggressive interaction can be observed among dogs sharing the same residence: (1) aggressive play that involves many of the behavioral components involved in actual fighting but without the intention to subdue or injure the opponent; (2) actual dominance fighting clearly designed to subordinate the opponent but without injuring it; and, lastly, (3) overt and damaging fighting intended to both subdue and injure the opponent. All three forms of fighting are involved in the establishment and maintenance of relative social dominance between individuals sharing the same home territory.

Most dogs sharing the same household establish remarkably stable dominance relations, needing only infrequent dominance threats and ritualized quarrels to maintain the status quo. Even so, fighting between resident dogs is a common complaint. The causes for such fighting are complicated and varied. Some authorities have speculated that the primary cause of instability is owner interference (Hart and Hart, 1985). In such cases, owners may feel sorry for the subordinate "underdog," which they may feel obligated to protect from the "bullying" dominant dog. This protective role may include punishing the more dominant dog while pouring affectionate consolation and comfort onto the subordinate. From the perspective of the combatants, it appears as though the meddling owner is taking sides, perhaps conspiring with the subordinate to overturn the dominant dog's position. The effect of such extraneous interference not only narrows the relative social status existing between the dogs, it may destabilize the situation and set off serious dominance contests whenever the owner is present (Hart, 1977). The owner's alignment with the subordinate antagonist may gradually forge an unwitting social alliance under which the subordinate is inadvertently encouraged and obliged to challenge the dominant dog's authority, at least whenever the owner is present. On the other hand, the dominant dog may progressively *feel* uncertain about the turn of events and shore up its compromised position by resorting to more frequent and damaging attacks, potentially resulting in serious injury to both the misled upstart and the interfering owner. Under such destabilized conditions, what began as a rare ritualized contest over dominance may develop into a serious pattern of escalating aggression between the dogs. Since such contests are never allowed to run a natural course, hostilities are kept at a high pitch of readiness, with the potential for an outbreak of fighting whenever the combatants meet in the presence of the owner. Because overt aggression invariably causes both combatants discomfort, they may, over the course of several fights, begin to view each other as conditioned aversive stimuli. Aversion, the close cousin of fear, causes the combatants to lose aggression-inhibiting affection for one another, further disinhibiting aggressive hostilities and setting the stage for injurious and potentially deadly fights. It is interesting to note that such dogs rarely fight when left alone, but this cannot be relied on in every case, especially where a high degree of interactive tension is present and where a history of serious fighting already exists. As part of their treatment program, some authorities have recommended leaving resident aggressors together when the owner is

absent (McKeown and Luescher, 1988), based on a questionable assumption that such dogs will not fight in the owner's absence. Besides the significant risk involved when the owner returns to potentially aggressive dogs vying for attention, resident combatants do occasionally fight when the owner is absent. Sherman and colleagues (1996), for example, found that 12 pairs of dogs (N = 73 cases) involved in household fighting fought at least one time during the owner's absence. Leaving resident aggressors alone together may result in very serious injury, so the practice should be avoided.

PREVENTION

Many breeds appear to be naturally preadapted to live in peaceful coexistence with other dogs and require little socialization to prevent problems. As previously noted, however, some dogs (especially the traditional fighting breeds) appear to be preadapted to *show* aggression toward other dogs as they mature and may require intensive socialization and training to gain control over their aggressive propensities. For these dogs, the appearance of another male dog represents a powerful releasing signal, triggering a very intense aggressive response. Further, although such behavior can be controlled through training, such dogs may never be completely trustworthy around other dogs.

The most important function of socialization for puppies is to encourage the development of repertoire of playful competitive behaviors. Aggressive play is composed of noninjurious agonistic sequences and species-typical cutoff, threat, and appeasement displays, with which dogs learn how to compromise, control, or defer to an opponent without aggression. Through such interaction, puppies learn that competition does not necessarily result in aggressive conflict. In addition to contact with other puppies, thoughtful efforts should also be made to expose puppies safely to other dogs of various ages. Exposure, however, is not enough to ensure a beneficial result. Socialization is a two-edged learning process and, depending on the sort of interaction involved, can result in either a positive or a negative outcome. Obviously, the benefit or damage produced by socialization depends on the sort of things that happen to puppies while they are exposed to other dogs. Socialization efforts can either lead to greater trust and security or result in increased mistrust and aggressiveness. A puppy should be exposed to other dogs under various environmental conditions and at various locations, but these encounters should always be carefully controlled and supervised. Unfortunately, in uncontrolled situations (e.g., the dog park), the threat of an all-out attack by a poorly socialized and aggressive dog is always possible. Some adult dogs are grossly disorganized in the way they play, whereas others are simply intolerant of puppies; in either case, such exposure may exert a lasting adverse impression on a puppy's attitude toward other dogs.

PART 2: TERRITORIAL DEFENSE

The concepts of territory and territorial defense are commonly appealed to in order to help explain certain forms of canine aggression. Defining precisely what territory is and in what sense a dog defends it is highly problematic, however. Some authors have entirely rejected the construct of territoriality. Moyer (1976), for example, writes,

> The definitions of territorial aggression frequently infer unobservable, anthropomorphic motivational states. These motivational states are projected to the animal and treated as though they were established observations. Territoriality has come to refer to a complex of diverse behavior patterns that vary widely across animal species and within species depending on the animal's sex, the characteristics of the intruder, the season of the year, the developmental stages of the animal, as well as a variety of environmental variables. (226)

The expression of territorial defense varies considerably among animal species, and there is little consensus about what *territory* actually means. The most generally accepted construct of territory is *a defended area.* A difficulty with this definition involves how one can reasonably differentiate territorial defense from protective aggression (Askew, 1996). Borchelt (1983) suggests that the term *protective* is

more descriptive and useful than the notion of territorial defense. He argues that dogs aggressively protect household members (humans and other dogs)—not a territory. Although the concept of protectiveness may solve some problems, Borchelt does not explain how one can be sure that the dog is specifically motivated to protect *others,* rather than simply responding to species-typical threat triggers, such as unfamiliarity or unwelcome approach-proximity (a territorial dimension). One way to test the hypothesis is to challenge the dog in the presence of a stranger or when alone. If the dog responds aggressively, it diminishes the likelihood that it is doing so to protect others belonging to the household. In any case, all protective aggression occurs within some *territorial* frame of reference—a given that is consistent with the *defended area* construct of territory. One way of analyzing how territorial defense and protectiveness may be related to each other is by appealing to distal and proximal causes. Intrusion upon territory may elicit preparatory aggressive arousal (distal influence), whereas close approach-proximity (proximal influence) may evoke a consummatory aggressive response. According to this analysis, intrusion upon territory represents an establishing operation making aggression more likely to occur and, should it occur, result in reinforcement if the intruder is expelled as the result of the aggressive action.

Self-defense and group-defense seem to be inextricably bound up with the defense of territory, that is, the space occupied by the group. After all, without the existence of a territory there is no place for the group to exist and, vice versa, without a group there is no territory to defend. Even the individual animal needs to *claim* a personal space and defend it against intrusion in order to maintain its safety and security. On a most basic level, territory and group defense cannot be adequately understood without reference to the other—the group and the territory within which it exists are mutually dependent constructs, just as the description of a circle depends on reference to both its perimeter and area. In some sense, the decision to emphasize territorial versus social variables depends on the focus of one's analysis. However, what is needed is an integrated analysis—a kind of behavioral geometry that simultaneously addresses both social and territorial variables. Social competition and territorial defense may operate within a single matrix of control-seeking vectors extending over both social (vertical) and territorial (horizontal) space. Among wolves, for instance, this territorial responsibility falls on the alpha and his deputies. When a breech in the territorial integrity of the pack occurs, it is the alpha that leads the defense and engages the intruding interloper; although lower-ranking members may participate in the rout, it is the alpha that is clearly in charge and leading the way.

Control-vector Analysis of Territory

Need Tensions and Control-vector Analysis

On a very fundamental level, all behavior exhibits the character of spatiotemporal directionality; that is, behavior possesses both temporal sequentiality (e.g., attention-intention-action) and orderly spatial points of reference (e.g., sees bird flying by, physically orients toward it, and finally jumps at the bird). Within this context, motivational interests may be conceptualized as need tensions, having particular goals or target objectives located within the animal's local space. To obtain goal satisfaction through the acquisition of these target objectives, an animal must change or control the environment in some way. Need tensions, in combination with their specific target objectives, form control-seeking vectors of variable magnitude that behaviorally converge upon relevant resources, places, and activities located in the environment [see Lewin (1936)]. The sum area containing these various resources, places, and activities represents an animal's social and territorial space. One way of understanding aggression is to analyze it in terms of competing control vectors belonging to *outsider* and *insider* conspecifics conflicting or colliding with each other over the same target resource. The group's living space is defended by deflecting, displacing, or destroying outsider control-seeking vectors that threaten its social and territorial space. Such defense not only protects the integrity of the group's space, it also preserves and reinforces the more or less stable

control-vector relations or *politics* operating within the group itself.

Control vectors are not only characterized by having directionality associated with need tensions, they also possess physiobehavioral properties such as inertia, momentum, velocity, and force. The probable outcome of conflict between two competing control vectors depends on the combined power of these properties exhibited by competitors. In other words, a more forceful control vector, exhibiting a high degree of momentum and velocity, will certainly deflect or displace a control vector possessing less-powerful vector properties. Control vectors possessing the same power vying over the same location or resource will result in momentary unstable equilibrium. Under the influence of growing levels of destabilizing anxiety and frustration, however, unstable equilibrium between competitors may result in one of four possible outcomes: (1) attack-fight (competitor displaced with potential for injury), (2) attack-retreat (competitor displaced with no injury), (3) cutoff or *lateral escape* (simultaneous deflection of both control vectors), or (4) threat-appeasement (competitor deflected from location or resource) (Figure 7.1). Under the influence of increased anxiety (reduced appetitive need tension) unstable equilibrium is most likely to result in lateral escape or appeasement, whereas under the increasing influence of frustration (enhanced appetitive need tension) overt combat is more likely to occur.

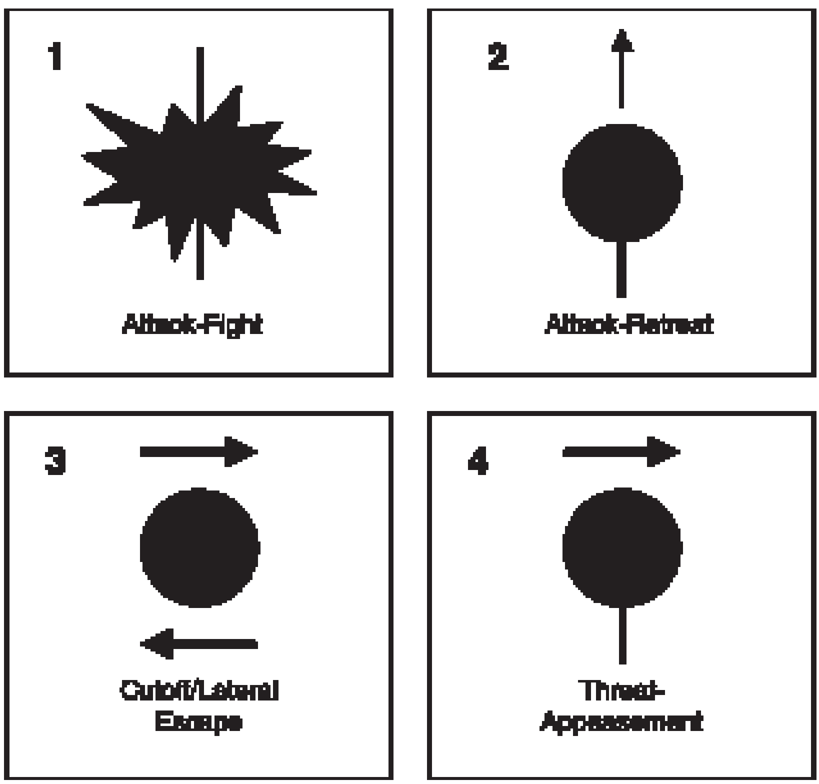

FIG. 7.1. Various control-vector conflict outcomes. **(1)** Equal control-vector magnitudes and need tensions under the influence of frustration over the same resource, with the result of attack and fight. **(2)** Control vectors of unequal magnitude but with equal need tensions converging on the same resource, resulting in attack and retreat. **(3 and 4)** Outcomes of unstable equilibrium (control vectors exhibiting equal magnitude and need tensions) under the influence of mutual anxiety (3) and increasing anxiety (4, *top arrow*) and increasing frustration (4, *bottom arrow*).

Horizontal and Vertical Organization of Social Space

Potentially disruptive interaction between group members exhibiting competitive control-seeking vectors is allayed by the exchange of ritualized threat-appeasement displays—displays designed to maintain adequate distance between *insiders* on both vertical (dominance hierarchy) and horizontal (personal living space) axes of social space (Figure 7.2). The center of territory for a domestic dog is within the home, presumably located precisely where the dog habitually rests or sleeps. At this central zone, the vertical social distancing effects of relative social status are most evident and potentially troublesome. As the result of organizing both horizontal and vertical aspects of group space, serious competition between insiders and their various control-seeking vectors is mitigated. According to this analysis, deference occurs when one individual's control-seeking vectors yield to the control-

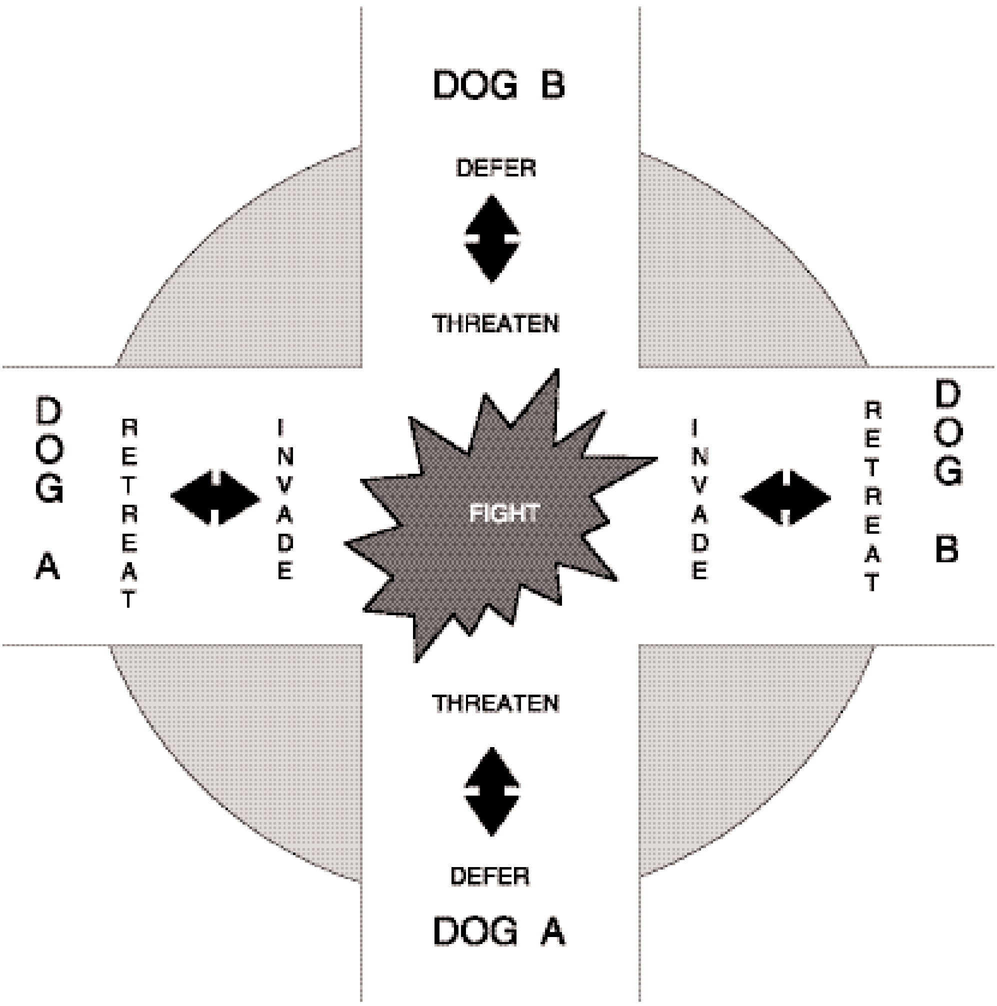

FIG. 7.2. The social space and interaction of a dyad over some common resource. The *vertical axis* of the cross represents the dominance hierarchy, and the *horizontal axis* represents territorial and personal space imperatives. Note that aggression is most likely to occur when both dog A and dog B are simultaneously threatening each other over the same resource or location.

seeking vectors of another by virtue of cooperation (alliance), deflection (ritual threat), or displacement (attack). The *dominant* leader, or alpha, can assert control-seeking vectors in any direction along both vertical and horizontal axes of the group's social space, while yielding to none.

Calhoun's Rat Universe

Of interest with respect to the foregoing vector analysis of territory and social organization are the experimental population ecology studies of Calhoun (1962) [see also Papero (1990)]. In one study, Calhoun captured wild rats and housed them in large enclosures or *universes* with access to unlimited food and protection against predation. Under protected conditions in which unlimited food was provided and predation prevented, he hypothesized that growth rates would be significantly inhibited as the result of social interaction developing under such conditions of abundance and safety. Calhoun made several important discoveries with respect to the development of territory and anomalous social behavior emerging under the influence of adverse environmental conditions. As the population of rats grew, more dominant individuals (corresponding to insiders) took up residency in one quadrant of the habitat, where they eventually established highly stable territories among themselves. As the population of this quadrant increased, weaker individuals (outsiders) were driven out and forced to migrate into other areas of the habitat. These migrant rats were typically low-ranking males. Over time, large numbers of these migrant males formed a colony quadrant of their own. Although more than enough food was provided to feed all the rats, the more dominant rats seized and protected the food, forcing the lower-ranking migrant males to *steal* opportunities to eat while the dominant males were either absent or sleeping.

In contrast to the more orderly quadrant belonging to high-ranking insider rats, the quadrant occupied by low-ranking outsiders was highly chaotic, with no individual rats being able to establish a viable territory of their own. As a result, the few females living in this quadrant were unable to breed and reproduce successfully. When in estrus, females were hounded by packs of male rats, all of whom made efforts to mount and copulate. Calhoun estimated that a female in estrus might be mounted as many as 1000 times in a single night. As a result, such females appeared highly stressed and were much less able to conceive and raise healthy rat pups. This picture was in sharp contrast to the high-ranking females living within the more orderly quadrant controlled by insider males. Under the protection of dominant insider males, insider females were better able to reproduce successfully and raise their young within the security of well-defended territories. Even though the enclosure was large enough to support as many as 5000 rats, Calhoun found at the conclusion of the study that only 150 rats had survived.

Detailing all of the ways in which control-vector analysis might be used to explain Calhoun's findings is not within the immediate scope of the present discussion, but a few points of convergence and interest should be emphasized. Theoretically, when control-vector conflicts reach a density that the group space can no longer support them, the group may experience general unrest and break up into *insider* and *outsider* subgroups, with each exhibiting their own internal and external control-seeking vectors. In the case of Calhoun's rat colony, only the insider rats developed a territory that was defended against the intrusion of outsiders. Even though there was more than enough food available for both insiders and outsiders, the stronger control-vector magnitudes of dominant insiders deflected or displaced outsiders from the common feeding area. Also, it is interesting that the outsiders were unable to form stable control-vector relations among themselves (dominance relations). This failure may have been due to their inability to control access to food and, most importantly, establish and defend nesting areas. The nesting area is presumably the center of territory and the point where vertical social space is first organized as the result of littermate interactions among themselves and the mother. Without a stable horizontal living space and central nesting area, the organization of vertical social space into stable dominant-subordinate status rela-

tions is not possible. Further, without the organization of stable status relations between dominant individuals and subordinates, there is little chance of forming territories within which productive nesting sites might be possible.

How Territory Is Established and Defended

Despite Moyer's misgivings, the concepts of territory and territorial defense remain useful empirical and heuristic constructs for understanding certain aspects of dog behavior. Besides overt territorial-group defense, dogs exhibit other habits that seem intended to communicate both social and territorial messages (e.g., urine marking and alarm or threat barking), perhaps advertising the group's presence or denoting some territorial implication, such as a warning to intruders that the area is occupied. Further, although group protection is undoubtedly a significant variable motivating territorial defense, many dogs exhibit intense aggressive arousal at doors, property boundaries, when chained, or when otherwise exposed to trigger situations presumably related to territory, whether the group is present or not. These observations suggest that the violation of territory in some way triggers or potentiates aggressive behavior independently of the presence or absence of a group to protect. Perhaps the violation of territorial boundaries functions as an establishing operation, preparing a dog to act effectively in defense of itself or its social group.

The propensity to defend personal space and surrounding territory against intrusion by outside conspecifics is a very common feature shared by a great many animal species. This so-called *territorial imperative* is grounded on several ecological and survival needs: resource conservation, population control and dispersion, reproductive needs, group protection, and social unity. The maintenance of territory involves several sensory modalities and methods of communication. Perhaps the most familiar forms of territorial advertisement among dogs are scratching earth, urine marking, and barking. Although territory is an area that is aggressively defended against intrusion, the ultimate function of territory may be to reduce aggression between competing conspecific groups. The establishment and defense of territory appear to parallel the aggression-reducing effects of status established among individuals sharing the same territory. Among most territorial species, the usual targets of territorial defense are conspecifics of the same sex, but other species may also be the object of attack. Even though the same sexes may share a territory by belonging to the same group, they do so by the establishment of vertical space, that is, the formation of a dominance hierarchy. In conjunction, territorial advertisements and dominance displays serve to reduce actual fighting between conspecific outsiders and conspecific insiders, respectively. The evolutionary success of territorial behavior is evidenced by its wide phylogenetic distribution and the tremendous variability that it presents from species to species (Klopfer, 1969).

Urine-marking Behavior

The habit of urine marking appears to be intensely engrossing, especially for socially dominant or aggressive dogs. Many dogs spend their entire walk outdoors doing little more than performing this intriguing ritual. Although primarily a male prerogative, females may also urine mark in a malelike fashion but rarely do so upon vertical surfaces, as is the common habit of male dogs. Mature dogs, like wolves, urine mark conspicuous objects by lifting and crooking their rear leg before squirting a small amount of urine onto a suitable object. Although this method of depositing urine is the most common, other variations are also used (see Figure 9.1), including a modified squatting form where dogs crouch slightly downward with one leg turned outward or slightly elevated (Anisko, 1976).

Urine-marking behavior is usually preceded by olfactory investigation of previously marked areas. At least one apparent motivation for this behavior is to identify and overmark areas scented by intruders. Many dogs lick the area being investigated, perhaps, to "freshen" it for closer scrutiny or to introduce a sample of it into the vomeronasal organ for

pheromonal analysis [see *Vomeronasal Organ (VNO)* in Volume 1, Chapter 4]. Occasionally, when a site proves particularly interesting, a dog may exhibit a flehmenlike behavior known as *tonguing* in which the tongue is rapidly and repeatedly pushed up against the roof of the mouth. Tonguing is sometimes associated with chattering teeth and profuse foaming of the mouth. After marking, many dogs make conspicuous scratching movements with their front and rear feet. These movements not only scar the ground but also cast dirt and debris several feet behind the marker, perhaps imbuing the material with identifying odors from scent glands located in the feet. It has been speculated that such scratching is done to spread the odor of urine, but this is not convincing, since the urine mark is rarely disturbed by the action. A more plausible explanation for the behavior is that it may serve to augment and amplify the scent mark visually, thereby providing additional clues and information about the marker's size, weight, state of health, general vigor, and other such details not readily exacted from the scent mark alone. Fox (1971) notes that such scratching is particularly likely when the dog is aggressively aroused by the presence of a strange dog.

Urine Marking and Territory

One theory of urine-marking behavior is that it helps to space aggressive individuals, thereby reducing competition over limited resources or mates. According to this general notion, chemosensory cues are integrated with other socially significant signals serving various roles in the regulation (e.g., increase, decrease, or maintain) of social distance between individuals and between conspecific groups. Dogs, in general, do not avoid areas marked by other dogs, although it would not be surprising in the case of particularly aggressive dogs to find some avoidance exhibited by dogs that had been previously attacked or worried by the urine marker. The urine-marking behavior of dogs often involves marking over previously established scent marks—a habit that appears to be highly provocative in its own right.

According to Anisko (1976), odors associated with urine marking may play a significant role in "the establishment and maintenance of dominance hierarchies and pair bonds, thereby stabilizing social organization" (291–292). Marking by urinating near or over areas previously visited by other dogs may function to secure or dominate the olfactory environment. An active social interchange results from the activity—a kind of urinary challenge and personal advertisement of the marker's presence. According to Bekoff (1979), the most likely time for a male dog to mark is after observing another dog marking. Socially dominant dogs appear to mark much more frequently than subordinate ones. Dunbar and Carmichael (1981) also found that male dogs are especially attracted to the urine deposits of other male dogs (especially strangers), tending to urinate more frequently on areas marked by dogs unfamiliar to them.

Although a great deal of speculation attributes a territorial function to urinary-scent marking by dogs, the empirical evidence is scant and conflicting. Many authorities have disputed the value of urine-marking behavior for establishing territory by dogs (Scott, 1967; Bekoff, 1979). Voith and Borchelt (1985) succinctly state the case against attributing a territorial function to urine-marking behavior:

> The term *marking behavior* is often used with the implication that it is territorial. This presumption elicits several problems. In the animal behavior literature, territorial behavior denotes defense of a well demarcated area. The relationship between territoriality and marking in dogs as well as many other animals is unclear. Many animals, particularly dogs, do not limit their marking behavior to their territorial boundaries. They mark multiple locations within the territory as well as areas other than the territory. Additionally, scent marking does not keep other animals out of territories. Dogs typically enter other dogs' territories to urine mark. (540)

Evidence for a Territorial Function of Urine-marking Behavior

Actually, some field evidence does support the notion that urinary-scent marking may play a functional role in the establishment of territo-

rial boundaries consistent with the aforementioned rather stringent criteria, at least in some populations of dogs. For example, Tinbergen (1951/1969, 1958/1969) made ethological observations of huskies in Greenland that support the notion that dogs do establish and defend stable territories. Huskies belonging to small pack groups consisting of 5 to 10 members communally defend and drive off intruders. They are also purported to have an "exact and detailed knowledge" of the extent of their neighbors' home territories and avoid areas where attacks are likely occur:

> The most interesting aspect of their behaviour was the fact that these packs defended group territories. All members of a pack joined in fighting other dogs off, the males being more aggressive than the females. This tendency to join forces when attacking strange dogs was the more striking since within each pack relations were far from friendly. . .. The clashes between neighboring packs were extremely interesting to watch. If they met at the boundary between their two territories, where the issues were even, neither group attacked. The males, and more particularly the leaders, growled at each other, and every now and then they lifted a leg and urinated—"planting a scent flag" as it can be called, for this is a means of staking out a territory and advertising it by smell. The state of tension in these strongly aroused, yet inhibited, champions also showed itself in acts which, in their similarity to human behaviour, were a source of endless amusement to us: they took it out on their own pack and the unfortunate dog of low rank who happened to come too near was growled at, or even severely mauled. (1958/1969:30–31)

In addition, Tinbergen found that young huskies did not participate in territorial disputes. Prepubertal dogs appear to lack a concept of territoriality, frequently violating neighboring areas defended by other huskies in spite of their harsh reprisals. Further, the dogs appear unable to learn where they can safely go and cannot go. Tinbergen (1951/1969) comments that "their stupidity in this respect is amazing" (150). As they reach sexual maturity at approximately 8 months of age, they appear to immediately understand, recognizing the topography of surrounding territories, and thereby learn to avoid attacks. He observed in the case of two dogs that several significant developmental changes took place within the course of 1 week, including the first copulation, first active defense of territory, and first avoidance of strange territory. These cumulative field observations seem to give credible support to the notion that dogs—given sufficient opportunity—establish and defend territorial boundaries.

Studies of stray and feral dog populations also suggest that dogs do establish stable groups and defend territory against intruders. For example, Font (1987), who studied a group of stray dogs in Valencia, Spain, found that stray dogs form stable social affiliations, involving the establishment of a dominance hierarchy and the group-coordinated defense of a communal territory. These observations appear to conflict with earlier findings by Beck (1973), which suggested that urban stray dogs form only loosely defined and temporary group affiliations. More recently, Boitani and colleagues (1996) reported that even more active and wolflike patterns of territorial defense and wariness are exhibited by feral dogs. They describe an incident that strongly suggests that dogs do appreciate the territorial implication of scent marking, at least with respect to the significance of lupine scent marking:

> The presence of wolves may, therefore, be an important factor shaping the dogs' home range and determining its location. . . No dispersal movements were observed, and only few brief excursions outside the usual home range were recorded. We have the impression that the dogs moved as if suddenly attracted by a scent: they went to check out the origin and possibly the nature and consistency of the signal. This impression was reinforced when the dogs went into the northern wolf pack territory at a time wolves are usually in oestrus. The dogs ran into and out of the area without stopping or slowing down, as if aware of the risks of being caught intruding in a wolf area. (238)

Although the role of urine-marking behavior for the establishment of territorial boundaries remains undecided, urine-marking behavior by domestic dogs may have been adapted to serve a more subtle "psychological" function

than the explicit demarcation of territorial boundaries. In particular, urine marking may provide dogs with an enhanced sense of confidence while ranging about the neighborhood, making it more familiar and secure. This notion is supported by the observation that puppies eliminate in familiar areas and, later on, at locations previously marked by their parents (Fox, 1971).

Urinary-scent Marking by Wolves

Although the role of urinary-scent marking by dogs for establishing territory is unclear, the activity does appear to serve a territorial function among free-ranging wolves. Peters and Mech (1975), who studied the scent-marking habits of wolves, concluded that scent marking *probably* does help to define territorial boundaries between neighboring packs. One observation they describe is strikingly similar to the incident reported by Boitani and associates. They saw a group of wolves chasing a deer that the pack had just severely wounded. The deer evaded capture by running into the territory of a neighboring pack. The trailing wolves gave up their chase as the deer moved into the adjacent territory. According to the authors, this behavior was out of keeping with the wolf's normal persistence in the pursuit of wounded prey, thereby suggesting that some territorial mechanism may have been at work. Unfortunately, they do not show how scent-mark identification might have played a vital role in the foregoing case. Other bits of circumstantial and anecdotal evidence (subject to much interpretation) are presented in support of the hypothesis. Surprisingly, even among wolves, the case has not been proven beyond doubt that urinary-scent marking is performed to delineate territorial boundaries. Nonetheless, it does seem reasonable to attribute a significant territorial function to scent marking by wolves.

Other studies investigating scent-marking behavior by wolves have shown that it is strongly influenced by both hormonal and social factors, especially relative social status (Asa et al., 1985). Among captive wolves, only dominant males and dominant females urine mark (with an exception of subordinates that are competing for higher status). Urine-marking postures reflect an individual's relative dominance. Additionally, marking behavior increases seasonally corresponding to periods of increased sexual activity and raised testosterone levels. However, seasonal variations of testosterone levels have little effect on the urine-marking activity of subordinate males, suggesting that social status modulates hormonal influences responsible for mediating the expression of such behavior (Asa et al., 1990).

Barking and Territory

In addition to urine marking, territory may be defended through vocal alarms and threats (acoustic marking). Dogs exhibit various forms of both alarm and threat vocalization as a means to draw attention to, or to ward off, intruders. Not only do auditory signals provide information about the approximate distance and direction of the vocalizer, they also provide biologically significant information about the identity of the sender (Heffner, 1976). A recent study of canine growling suggests that *formants* or frequency patterns contained in a growl may give receivers vital information about the sender as a potential opponent, with smaller and larger dogs producing distinctive auditory formants (Riede and Fitch, 1999). In addition to the size of the opponent, growling variations appear to express important information about the sender's readiness to attack, degree of confidence, or willingness to submit. Whereas low-frequency, broad-band growling is associated with threats, high-frequency whining is most often associated with submission. Social and territorial threat displays incorporate a variety of sensory modalities to help amplify and disambiguate the sender's intention and meaning.

Alarm barking is highly valued by most dog owners but may represent a nuisance to neighbors (Senn and Lewin, 1975). Such barking behavior warns the group of a pending threat, as well as countering the intruder's advances further into the home territory; that is, barking appears to serve a dual territorial and group-defense function. Alarm barking is usually sustained as long as an intruder remains present. It is rhythmically organized

with brief pauses of silence of various lengths apparently used to follow the intruder's movements. A less loud and sustained alarm-barking sequence takes place when a dog is surprised by an outside stimulus that it cannot immediately identify as an intruder. Surprise or startle barking involves low-volume "woof, woof" sounds followed by a brief period of silence and more energetic alarm barking, if warranted. Threat barking frequently develops out of alarm barking, especially in situations in which an intruder continues to advance upon the territory. As barking escalates and becomes more threatening, it takes on a more aggressive and threatening character. Threat barking may be interspersed with bouts of growling, snarling, lunging, or snapping at the intruder. If the intruder continues to advance, the dog may either launch an attack or flee from the situation, perhaps continuing its threat barking from the advantage of a more secure position.

Free-floating Territory

The operative definition of territory is *a defended area.* This definition is neither limited in terms of the size of the area nor is it qualified by the amount of time that the area has been occupied. Accordingly, territory can be either small or large or defended over short or long periods (Immelmann, 1980). Some highly dominant dogs appear to take possession of any area in which they happen to be and will defend it against the intrusion of other dogs or people. When such dogs are first introduced to a new area, they often immediately set out to urine mark the entire perimeter of the area systematically before taking interest in other activities**.** The mere fact of *being* somewhere is sufficient for such dogs to prompt energetic efforts to establish a territorial presence over the area and to defend it against the intrusion of other male dogs and people. A territorial imperative appears to follow or *float* with such dogs, moving fluidly from one place to the next with great ease. Each new area is secured and defended with an equal aggressive tenacity.

Some of the peculiar territorial adaptations (e.g., free-floating territorial defense) and associated hypertrophied behavior patterns (e.g., barking and urine marking) may be the result of artificial pressures placed on dogs during domestication. Under the influence of domestication, natural pressures conducive to the organization of species-typical territorial defensive behavior are absent. Domestic dogs are neither required to hunt for their own food, locate mates, nor rear their young under adverse natural conditions. In fact, not only are dogs unique in that they do not hunt for a living or form lasting pair bonds with their mate, male dogs are the only canids that do not contribute to the care of their progeny. The absence of such pressures as these may help to explain some of the unusual aspects and variations of canine territoriality:

> The term "territorial" aggression is applicable to species in which the actual securing and holding of territory has adaptive advantage. In the domestic dog, the function of this behavior has apparently generalized or been selected to include protection of significant persons in the dog's social unit as well as places in the environment. (Borchelt, 1983:58)

An important effect of domestication is the alteration of behavioral thresholds controlling freeze, flight, and fight responses. Selective breeding has exercised a pronounced influence on the development of breed-specific variations in territorial defense by artificially enhancing or diminishing relevant traits and behavioral thresholds (Price, 1998).

Territorial Aggression versus Group Protection

In practice, it is often difficult to differentiate defensive aggression from territorial aggression (Askew, 1996). One useful way to differentiate defensive aggression from territorial aggression is to determine whether fear is present as a significant motivational variable, and whether behaviors indicative of territorial motivation (e.g., barking and marking) are present or absent. Dogs exhibiting strong territorial aggressive tendencies are typically more assertive and confident. Also, the contexts of aggression are often highly specified, involving other male dogs and unfamiliar

human targets intruding on significant territorial boundaries or areas. Territorial aggression involving a high degree of assertiveness can also be differentiated from defensive aggression by the latter's response to behavioral intervention. Defensive behavior is often highly responsive to behavior modification, whereas assertive territorial aggression may strongly resist training efforts. Territorial aggression and group protection cannot be entirely differentiated, because they are mutually dependent constructs. Group protection is the prerogative of a highly dominant dog that appears to respond to territorial intrusion as an establishing operation for the expression of assertive and threatening behavior toward the intruder. Aggression with respect to the protection of others (e.g., children) may be a generalized form of maternal-paternal aggression.

VARIABLES INFLUENCING TERRITORIAL AGGRESSION

Canine territorial aggression is inextricably entwined with the development and protection of the group's integrity as a social and cooperative unit. Protective behavior both establishes territorial boundaries and sets limits between the group and other conspecifics or people not belonging to it. A number of social and environmental factors facilitate social distancing and influence the character of territorial aggression in dogs. Among the most important of these are frustrative restraint, frequency of territorial violation, social facilitation, crowding, and ambience.

Frustration and Restraint

Confinement in the house, behind a fence, or tied to a chain tends to invigorate territorial behavior. Unlike wolves and feral dogs, a domestic dog's freedom of movement is artificially constrained and limited by both physical and social barriers. Such constraints not only define the boundary of a dog's home territory, they also prevent escape to safety in case of danger. These artificial boundaries are often vigorously defended against intrusion. Under conditions of confinement in which a dog's freedom of movement is constrained, it may feel trapped, vulnerable, frustrated, agitated, and thereby become progressively more and more vigilant and aggressive toward the potential threat of intruding strangers and vagrant dogs. In general, the effect of frustrative restraint is to invigorate or distort the species-typical defensive tendencies present in dogs.

Fences, doors, and windows are particularly problematic, since these barriers simultaneously define a dog's territorial boundary, with the potential intruder located just on the other side, leaving little room for other options to present themselves or develop. Defending what little space is left before the territory is breached becomes critically important for a confined dog, especially if escape is not a viable option. There is no buffer zone or room to negotiate other courses of action under such circumstances of territorial intrusion. This state of affairs is especially problematic for dogs exhibiting relatively low fear thresholds and defensive aggression. The resulting defensive behavior of such dogs is often frenetic, compulsive, and extreme. Under situations in which escape is not possible, fearful dogs possessing a strong tendency to engage in defensive aggression are often highly vigilant and prepared to threaten or attack strangers intruding upon their domain. Aggressive tensions and wariness around disputed boundaries (e.g., doorways and fences) can reach compulsive levels.

Finally, some evidence suggests that frustration over food may increase territorial aggression. Jagoe and Serpell (1996) found that dogs fed after their owners showed significantly more territorial aggression than dogs fed before their owners. Speculating, they attributed this tendency to feeding schedule-induced differences of general arousal. They also noted that making a dog wait may alter its perception of the value of food, perhaps making it more defensive over food when confronted with intruding strangers. These explanations are a bit of a stretch given the limited data presented, but it may be important from a husbandry and preventative perspective to feed dogs *before* rather than after the family eats—in opposition to the advice of some trainers and behav-

ioral counselors regarding the benefits of feeding the dog in a reverse order (Rogerson, 1988; Seksel, 1997). Further, contrary to the opinion of Rogerson about order of feeding, Jagoe and Serpell found no evidence indicating that feeding the dog before the owners ate increased the risk of the dog developing dominance-related aggression.

Effect of Frequent Territorial Intrusion

Dog bites are a common cause of injury to mail carriers, with 2851 of them having been bitten in 1995 (U.S. Postal Service statistic). The daily intrusion of mail *violating* the territorial integrity of the door is often the object of fierce aggression, with the dog attacking and tearing up the mail as it is pushed through the letter slot. The mail carrier's daily "intrusion" upon the dog's home territory may gradually heighten its aggressive efforts into a frenzy. Serious problems have developed out of this perceived intrusion and violation of territory. During such encounters, dogs have crashed through glass windows for the opportunity to attack a mail carrier, even ignoring the chemical-spray deterrents used for defense against such occurrences. Since mail carriers are common targets for territorial aggression (Beck et al., 1975), special precautions should be taken to prevent such aggression from developing. A couple of simple measures often help to prevent or reduce such tensions: (1) let the dog regularly meet and accept treats from the mail carrier, (2) when a mail slot is used have the mail carrier insert a biscuit with the mail for the dog's pleasure, and (3) consistently discourage aggressive displays. In extreme cases, the mail should delivered to a mailbox located some distance away from the front door.

Sources of Territorial Agitation: Fences and Chains

Territorial defensive excesses are often expressed in a compulsive form along fences toward other dogs and passersby. Konrad Lorenz reports a comic incident involving territorial aggression between two dogs *defending the same fence line* (Lorenz, 1954). He describes how these two enthusiastic fence fighters were surprised to discover one day that a portion of their shared fence had been removed for repairs. The two dogs, accustomed to run along the fence carrying on a spirited exchange of threat and counterthreat, found themselves face to face without an intervening barrier between them. After a brief stay of hostilities, the erstwhile combatants broke the lull of bewilderment by retreating back to the part of the fence still standing to continue their battle safely. Unfortunately, this amusing anecdote defines the extreme exception rather than the rule. Most fence fighters would readily welcome the opportunity to engage in actual fighting, often jumping over or digging under fences to do so. In addition, serious attacks have been delivered on innocent children and adults reaching through fences or car windows to pet a dog—attacks that sometimes occur without much warning or indication of the dog's aggressive intentions. Children playing near a fence or in view of a chained dog are common sources of agitation, and measures should be taken to prevent such contact and stimulation. This situation is compounded when children actually tease and taunt a dog. Many cases involving the chasing of bicycles and cars appear to involve similar territorial issues.

The invigoration of aggression by restraint can be seen in an exaggerated form in situations where a dog is habitually restrained on a chain and stake. Some of the most severe and *deadly* canine attacks toward humans have been launched by chained dogs or dogs that have broken free of their chain. Sacks and colleagues (1989) reported that among pet-related mortalities that 28% resulted when a child approached too close to a chained dog. In 36% of these cases, the children were killed after gaining unauthorized access to a fenced area containing the dog. Among stray dogs, 35.7% of the fatal attacks were delivered by a dog that had escaped a fence, pen, or other form of restraint. The following is a typical report:

> HAMILTON, Ohio, Nov. 18 (UPI)—Butler County Animal Shelter officials will determine Monday whether a Siberian husky and a chow will be destroyed for attacking and killing 7-year-old Ethan Fricke.

> The 3-year-old husky and 18-month-old chow killed Fricke at the child's uncle's home in Ross while his parents, and other relatives were attending a Saturday baby shower.
>
> The uncle, Nick Toon, said he warned the boy not to play with the dogs unless an adult was present.
>
> "I tried to explain to him that even though they are friendly, they could hurt him because they are bigger and stronger than he is," Toon told the *Cincinnati Enquirer.*
>
> Sheriff Don Gabbard said the boy was playing alone and went into a fenced area of Toon's backyard where the dogs were chained.
>
> Gabbard said one, or both dogs, bit the child, severing an artery in his neck.
>
> Sheriff's deputies say Fricke died less than one-hour after being attacked.
>
> "If the decision is to destroy them, I will agree with that," Toon said, "But I would like to say to others who own chow dogs that they shouldn't run out and destroy them because of this. A lot of people will say they are vicious, but they are not. This was just an accident."
>
> A service for Fricke was scheduled Wednesday at the Fairfield West Baptist Church.

Moral: A chained, intact, male dog is a statistical menace to public safety.

Social Facilitation and Crowding

Dogs living in communal situations are subject to additional pressures that may intensify territorial defensiveness. A well-know factor augmenting territorial aggression is social facilitation. The mere presence of another dog alters the strength of shared or allelomimetic behavior, including group-coordinated territorial defense. Most dogs are much more aggressive when in companionship with other dogs acting out aggressively. This fact is commonly employed by police and military-dog trainers who frequently agitate dogs in group (line agitation) to build confidence and aggressiveness. Under the influence of social facilitation, dogs tend to intensify their behavioral efforts beyond the magnitudes that they would exhibit if alone. When social facilitation is combined with crowded circumstances, especially involving untrained or poorly socialized dogs, the situation is ripe for the outbreak of frequent and potentially serious displays of territorial aggression. Dogs, unlike other species, appear to accommodate crowded conditions without exhibiting a significant increase in agonistic behavior, especially in circumstances where a stable dominance hierarchy has been established among group members before they are exposed to crowded conditions (Pettijohn et al., 1980).

Ambience

Pettijohn (1978) reported interesting findings concerning the relative effects of various environmental influences on the expression of agonistic behavior among male Telomian dogs. Although not specifically concerned with territorial aggression, the study nonetheless provides obvious environmental management strategies that may have practical implications for manipulating aggressive thresholds. He observed changes in agonistic interaction under the influence of various environmental conditions, including a control room (same as home pen—3.0 × 3.5 meters kept at 21°C), cold room (10°C), bright light (floodlights placed in the corners of the room), dim light (lights turned off and windows covered), and small space (room reduced to 3.0 × 1.8 meters). The dogs were all 7 months of age. He found that the total number of attacks, vocalizations, and retreats were most significantly influenced by the amount of light present in the test situation. Dim light increased agonistic interaction by 32%, whereas bright light decreased it by 28% relative to agonistic behavior occurring under normal lighting conditions. These results are striking and pronounced, but it is unclear how relative light intensity might affect the expression of aggressive behavior.

Stressful exposure to loud and sustained noises may also lower thresholds for the exhibition of offensive aggression, perhaps as the result of increasing irritability. Some dogs appear to have a greater tendency to exhibit aggressive behavior during or immediately after noisy household repairs. Two dogs come to mind where sound stress appears to have played a significant role. In one case, involving an adult male Labrador retriever, workmen used a jackhammer to remove an asphalt driveway. During the 2 days while the work was being done, the dog observed the various activities from the vantage of the front porch

and did not show any signs of agitation or aggression. At the end of the second day, however, when a workman approached the front door, the dog darted at to him and bit him on the leg. In another case, an adult male Labrador mix was left outside in a garden while workmen were occupied grinding down several tree stumps. After several hours, the dog approached and threatened one of the workmen, backing him across the yard with threatening barks and lunges. Neither dog exhibited threatening behavior before or after the aforementioned incidents. As a general rule, when work is being done that produces loud noises, dogs should be kept indoors and insulated from such stimulation.

PART 3: FEAR-RELATED AGGRESSION

Fear and Aggression

Fear is a major motivational factor in the expression and inhibition of aggression. The role of fear is a bit complicated and equivocal, since fear usually inhibits aggression under most circumstances involving moderate levels of fearful arousal. For example, trainers of circus animals, especially those working with large cats, put their lives at risk on the assumption that fear can inhibit aggression. Such training with cracker-whips, blank guns, and various threatening props deliberately serves to evoke and carefully balance the opposing tendencies of flight or fight in such animals. Essentially, such training proceeds to establish control by alternately evoking fear and aggression. Whether flight or attack occurs during such challenges depends on past training and relative thresholds for running away (*flight distance*) or holding ground (*critical distance*). Under conditions of abrupt and intense aversive arousal, both fear and anger may be simultaneously evoked—a potentially lethal circumstance for large-cat trainers. Under such conditions, efforts to suppress aggressive behavior by punishment may not reduce aggression but instead precipitate a spiraling escalation of fear and anger. Such efforts are especially problematic in cases in which dogs lack a safe alternative with which to control the evocative situation.

Fear and Avoidance-motivated Aggression

Fearful territorial defense occurs in situations involving intense threatening arousal that cannot be otherwise escaped, that is, when flight is blocked. When threatened, dogs in such situations attack only as a last resort and then only if their freedom of movement is blocked. Fearful aggression is not employed to defend a territorial boundary but to establish a route of escape from an otherwise inescapable and threatening situation. As a result of successful escape, however, dogs may learn to attack more easily (threshold lowered) in the future under the influence of similar circumstance and territorial triggers. Avoidance-motivated aggression (AMA) develops in situations where a dog has learned that aggression will likely work to control some threatening situation. Although defensive aggression theoretically stands opposite to offensive aggression on the agonistic continuum, AMA is often difficult to distinguish from offensive aggression, especially as the dog becomes progressively confident in its ability to control the threatening situation through aggression. In an important sense, aggression, whether it occurs to secure escape or to defend some resource or area, is motivationally unified under the construct of control. Control-related aggression includes aggression occurring under the influence of escalating adversity that thwarts a dog's ability to control an attractive situation or impedes its ability to escape or avoid an aversive one. In other words, a frustrated or anxious dog may assert itself aggressively to secure or alter a motivationally aversive situation. Interestingly in this regard, defensive and offensive aggression may be alternately present in the same dog. Functionally speaking, most forms of dominance- and fear-related aggression are motivated to establish control over a frustrating or threatening social situation.

Fear and Territorial Aggression

Fear-related aggression is highly directional, situationally specific, often precipitated by a territorial intrusion, and highly predictable. Fear-related aggression often occurs under an inhibitory influence, with the target receiving

ample preliminary signs and threats before an inhibited attack is launched. This feature is frequently lacking in *dominance aggressors,* who may attack without noticeable warning and deliver a hard, *angry* bite. A fearful dog usually attacks in an inhibited and nervous manner, biting only hard enough and long enough to escape the feared situation. The target may be children, adults, or other dogs (frequently without respect to sex), and such attacks occur under a variety of provocative circumstances. Obviously, reducing fear is central to effective behavioral control and modification of fear-related territorial aggression. However, in addition to fear-reduction efforts, fearful aggressors need to learn more constructive ways to control evocative social transactions and territorial transitions without responding aggressively.

A strong association exists between territorial aggression and fear. In fact, fear-related aggression is commonly misinterpreted as territorial aggression. Interestingly, both fear-related and territorial aggression are unaffected by castration (Hopkins et al., 1976), perhaps reflecting a similar motivational substrate shared by the two forms of aggression. Fearful dogs are frequently nervous and reactive during territorial transitions (e.g., meeting guests at the door) or under circumstances in which their personal space is limited or their movements are constrained. Such dogs may engage in sustained, frenetic barking efforts, perhaps while simultaneously backing away from the unwanted advance of guests. A fearful dog's reactions are particularly intense in situations involving close confinement. For example, extreme reactions (e.g., sustained barking, lunging, growling, and air snapping) are commonly observed among such dogs when they are approached while restrained or confined (e.g., in a crate or automobile, or on leash). These dogs are probably more worried about defending themselves than defending their territory, but arbitrarily separating these defensive constructs is not useful. Although a dog may react aggressively to defend itself, the trigger is often related to a threat of territorial intrusion. Identifying these territorial triggers, altering them, or changing the dog's expectations with respect to them are important aspects of the behavioral management of such problems.

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8

Social Competition and Aggression

Animals can be both sociable and aggressive. At first sight the two seem impossible to reconcile, for if a fellow species member can arouse both friendly impulses of attraction and those of repulsion one might expect the result to be insoluble conflict. And it is true that all animals living in closed groups have had to resolve this problem. In order to do so a number of inventions have proved necessary. Among other things, rites that appease and establish bonds had to be evolved. Aggressive animals that live in groups are always busy keeping the peace.

IRENÄUS EIBL-EIBESFELDT, *Love and Hate: The Natural History of Behavior Patterns* (1971)

ASSESSMENT AND IDENTIFICATION

Dominance aggression is often described as the most common behavior problem presented for treatment to behavior specialists and counselors (Landsberg, 1991) (Figure 8.1). Most dogs fitting this category either have threatened or have actually bitten a family member. Dominance-related aggression is generally identified by two criteria present at the time of attack: (1) a perceived threat (e.g., gesture, posture, or contact) and (2) intrusion upon a situation occupied by the dog (e.g., possessions, places, and persons). For example, aggressive attacks may occur when an owner attempts to restrain or punish (vocally or physically) the dog or exhibits challenging postures, dominant-appearing gestures (direct eye contact), or even very subtle or benign actions such as

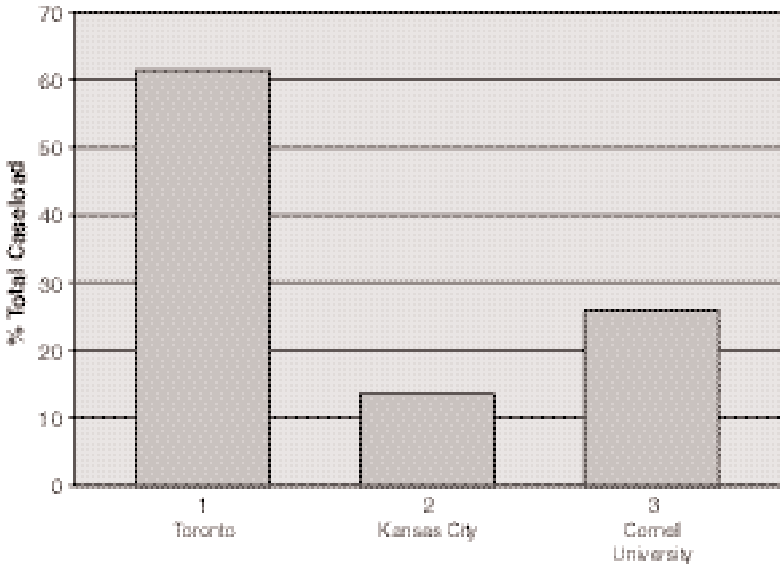

FIG. 8.1. The percentage of cases involving dominance-related aggression for three animal behavior clinics. From Landsberg (1991).

unwelcome petting (contact aversion). Dominance threats or attacks occur under a variety of situations, such as when an owner reaches for toys, food, or other prized possessions located near the dog; when disturbing or attempting to remove the dog from resting areas, especially beds and sofas; when disturbing the dog while in the company of a particular family member (especially when the dog is on the person's lap); and when the dog is put in its crate or the owner attempts to leave the house (Table 8.1).

A distinguishing characteristic of dominance aggression is that it is often situational or object specific and socially selective. For example, it is not uncommon for a dog to be dominant over another dog or family member in one situation but submissive toward them in another. In addition, dogs may exhibit highly selective dominance tendencies, being aggressive, for example, only when in possession of a particular item, while eating, or while in close association with a particular location or person. Aggressive efforts to control a situation appear to be related to motivational factors (biological needs and appetites). Dogs with strong appetitive interests may assert themselves exclusively over food or chew objects, whereas other dogs with strong attachments toward a particular individual may become aroused only when the object of their affection is approached. Still other dogs may become reactive only when their freedom of movement is momentarily constrained, when various parts of their body are physically manipulated, or when intruded upon while resting or sleeping. The selective nature of these arousal situations suggests an underlying differentiation of motivation with respect to those resources and activities. Consequently, treatment programs should address these functional motivational considerations as well as manage coactive emotional influences that may exert pronounced effects on aggression thresholds. These coactive influences and effects on aggression include

1. Frustrative invigoration of appetitive motivation resulting in lowered thresholds for offensive aggression
2. Increased anxious vigilance and lowered thresholds for defensive aggression
3. Increased contact aversion and lowered thresholds for the elicitation of reflexive aggression in response to discomfort or irritability

TABLE 8.1. Control-related dominance aggression: sources of conflict

Situations	Actions
Locations Bed Furniture Sleeping area	Aggression may occur if the dog is disturbed while resting or sleeping. Commonly occurs if the dog is forcefully removed from furniture or a bed.
Doorways	The dog is prompted to move away from the doorway. touched, or stepped over.
Crate	The dog attacks when forcefully placed into a crate or approached while confined.
Rooms	The dog becomes aggressive as the owner enters or leaves the room or house.
Objects Food Prized objects Attachment figure	The dog may become aggressive if approached while eating, chewing, in possession of some prized object, or while in close contact with a family member. Attacks may occur after the dog has been chased into hiding under furniture or when an item is forcefully removed from the dog's mouth.
Tactile stimulation Petting Hugging	In some cases, minimal contact stimulation may evoke a strong aggressive response (low-threshold aggression). Aggressive dogs may not show an affectionate response to petting. They are often aloof and emotionally reserved.
Grooming (e.g., touching ears, feet, nails) Restraint (e.g., lifting, rolling on side, grabbing scruff, clamping muzzle, attempting to put on halter-type collar, forcefully pushing or pulling dog) Punishment	Many of these actions may be perceived as a threat by the dog. It is often difficult to differentiate dominance-related, irritable, fear-related, and avoidance-motivated aggression. All of these forms of aggression fall under the heading of control related and may occur in a variety of situations.
Auditory stimulation Reprimanding Threatening yelling	The dog may become aggressive (snarling or snapping) when yelled at or reprimanded.
Visual stimulation Staring Close eye contact	The dog may become aggressive when stared at—diagnostic for dominance-related aggression. Its pupils may exhibit a reddish glow just before an attack.

After Voith and Borchelt (1982).

Although dogs exhibiting dominance aggression may often defend possessions, not all possessive aggression is motivated by social dominance (Borchelt, 1983; Reisner, 1997). Wright (1980) observed among German shepherd puppies that relative social dominance and competitive (possessive) aggression occurs with some apparent degree of independence, depending on the relative familiarity or unfamiliarity of the situation in which the interaction takes place [see *Social versus Competitive (Possessive) Aggression*]. Among wolves, an otherwise submissive individual may actively defend the possession of food against higher-ranking pack members (Mech, 1970). Mech suggests that possession within an *ownership*

zone of approximately 1 foot from the wolf's nose gives the possessor rights to defend and control the object against intrusion. In an experiment in which an otherwise submissive wolf was given possession of large piece of meat, the subordinate was able to defend its rights of possession aggressively against higher-ranking pack members that had been starved for 72 hours. Interestingly, after eating half of the meat, the subordinate left the prize and, apparently feeling an obligation to appease the alpha pair, alternately approached both of them with abject submissive postures and gestures seeking reconciliation. From the alpha male, he received very severe growling, snapping, and biting, causing the subordinate to fall and roll into a passive-submission posture. From the alpha female, the active-submission behavior produced regurgitation. These events clearly show that possessive aggression may operate under the influence of motivations other than the assertion of social dominance or rank. Consequently, when occurring independently of other forms of dominance aggression, possessive aggression may be more properly understood in terms of defensive motivations rather than offensive ones.

The dominance aggressor commonly exhibits other forms of aggressive behavior, as well, including territorial defense, intermale fighting, and xenopic (toward strangers) aggression. Many dominance aggressors, however, are quite specialized, threatening and attacking only family members. Other dogs exhibiting dominance aggression may threaten or attack guests after an exciting and disarming show of affection and attention-seeking behavior (Reisner, 1997). Some particularly sensitive and reactive dogs possess an extremely low threshold for the exhibition of disproportionate and damaging aggressive attacks. A low-threshold dominance aggressor may attack during benign dominance challenges involving various movements, postures, or intentions perceived by it as dominance or *control* threats. These perceived challenges include bending over the dog, talking to the dog, putting on or taking off the dog's collar, innocuous eye contact with the dog, or simply petting the dog's head or back. Some interesting experimental evidence suggests that a reflexive defensive reaction may be neurologically hardwired and elicited in response to tactile stimulation (Konorski, 1967). Dogs stimulated by an air puff directed into the ear usually exhibited a strong aggressive response toward the apparatus and would attempt to bite the experimenter's hand if it was nearby. Konorski also reported that decorticated dogs exhibited a stereotypic aggressive response whenever they were touched on the back. These findings suggest the existence of a reflexive mechanism mediating aggressive behavior. Perhaps, in normal subjects, such defensive mechanisms are modulated and controlled (inhibited) by higher cortical centers. In the case of some aggressive dogs, these inhibitory mechanisms may be rendered dysfunctional by physical disease or neurotogenesis. This possibility is especially pertinent in those cases involving a sudden increase in irritability and unpredictable attack occurring while the dog is being petted on the head or back, when being talked to at close quarters, or when the victim playfully blows air into its face.

The evaluation of dominant-aggressive dogs, especially those cases involving episodes of sudden onset or unusual signs, ought to include a thorough veterinary examination. This exam commonly includes various blood panels, urinalysis, and fecal evaluation. In areas endemic with Lyme disease, a Lyme test should also be performed. In addition, thyroid function (Michigan State Test) is assessed in some cases involving atypical presenting signs or other indicators suggesting thyroid involvement [e.g., lethargy, obesity, poor coat quality and alopecia, cold intolerance, and avoidance of exercise (tires quickly)]. Thyroid dysfunction has been considered a relatively rare (Reinhard, 1978) or insignificant (Polsky, 1993) factor in the expression of aggression. However, recently it has been suggested that thyroid insufficiency may play a much more important role than had been previously suspected. Aronson (1998) remarks that one reason for the apparent lack of a positive correlation between aggressive behavior and hypothyroidism might be due to the lack of appropriate testing to detect its presence. Not only has she found a clear link between thyroid insufficiency and aggression, she has also implicated a thyroid factor in the expression of a variety of behavior problems, including generalized fear, separation anxiety,

compulsive disorders, hyperactivity, and seizure activity. Although thyroid supplementation may not represent a cure for such problems in hypothyroid patients, it appears to exercise an ameliorative effect:

> While correcting the thyroid imbalance may not provide a complete resolution of the behavior problems, it is an extremely rare animal that shows no improvement, and certainly none shows a deterioration in behavior following treatment. In the future, it is possible that if we test for other endocrine and metabolic parameters, we will discover additional links between systemic conditions and behavior problems. (97)

Some forms of explosive and unpredictable aggressive behavior may be caused by a variety of neuopathologies, including seizure activity (Dodman, 1992). Affected dogs may appear disoriented and exhibit a glazed or deep reddening of the pupils, just before launching into an uninhibited attack. Owners often report that their dogs appear momentarily "possessed" by a paroxysm of aggressive behavior occurring rather independently of identifiable provocation present at the time of attack. Following attacks, dogs may appear dissociated from the event, often acting as though contrite for their behavior. Episodic rage syndrome (sometimes referred to as idiopathic or episodic dyscontrol syndrome) is relatively rare and believed by some authorities to be the result of epileptic seizure activity or damage in limbic areas responsible for the regulaton of aggressive behavior (Voith, 1989). The attacks may occur episodically on a monthly or more frequent basis (Hart and Hart, 1985). Certain breeds appear to exhibit a predisposition for the disorder; English springer spaniels (springer rage syndrome), Bernise mountain dogs, cocker spaniels, St. Bernards, Lhaso apsos, and many other breeds have been reported to exhibit the disorder. Voith (1989) emphasizes the close relationship between unpredictable aggressive attacks and dominance aggression. She notes that such attacks are typically directed toward family members and are provoked under the influence of low levels of stimulation (e.g., petting or ordering the dog to do something). Borchelt and Voith (1985) reported that differential diagnosis can be facilitated by alternately adminisitering epileptogenic and antiepileptic drugs and observing the dog's behavior for aggressive kindling effects or suppression (see *Epilepsy* in Volume 1, Chapter 3). In cases where pathophysiological causes are not identified, episodic attacks would probably be better described and understood in functional terms of *low-threshold dominance aggression* rather than episodic rage syndrome.

The obvious need for accurate diagnostic testing and differential diagnosis of possible underlying disease conditions emphasizes the importance of an active partnership between veterinarians and dog behavior consultants in the resolution of behavior problems. Further, since pharmacological intervention is often employed (especially in severe cases), a consulting veterinarian can prescribe and monitor necessary medications. Ideally, the treatment of dominance aggression should proceed as a team effort, consisting of the client's veterinarian, a consulting veterinary behaviorist, and a professional trainer/behaviorist.

Many authors have emphasized the role of status infringement as a putative cause of dominance aggression, but as will be shown throughout this chapter, what exactly is meant by such notions as social dominance and dominance aggression is far from clear and unambiguous. This is a highly problematic state of affairs, because many of the treatment protocols used to modify this relatively common and dangerous problem are based on assumptions derived from these various theories, especially the belief that treatment efforts should focus on altering a dog's relative status. Unfortunately, however, there is "no convincing evidence" that the usual behavioral treatment programs aimed at reversing the dominance hierarchy actually achieve such changes (Reisner, 1997). Not only are such dogs potentially dangerous, they are also at considerable risk of euthanasia, unless effective behavior modification and training are brought to bear on the problem (Reisner et al., 1994). However, even in cases where appropriate behavior modification is applied, dominance aggression problems are rarely cured. Line and Voith (1986), for example, found that treatment produced some benefit in most dogs (N = 24), but when asked several months later only 1 of 19 dog owners indicated that the aggression problem had been completely suppressed.

CONCEPT OF SOCIAL DOMINANCE

Long ago, Konrad Most (1910/1955) articulated the following influential social-dominance theory of dog aggression:

> In a pack of young dogs fierce fights take place to decide how they are to rank within the pack. And in a pack composed of men and dogs, canine competition for importance in the eyes of the trainer is keen. If this state of affairs is not countered by methods which the canine mind can comprehend, it frequently ends in such animals attacking and seriously injuring not only their trainers, but also other people. As in a pack of dogs, the order of hierarchy in a man and dog combination can only be established by physical force—that is, by an actual struggle in which the man is instantaneously victorious. Such a result can only be brought about by convincing the dog of the absolute physical superiority of the man. (25)

This general theory is familiar to anyone with the most casual exposure to the dog-training literature. Besides the injection of misleading adversarial motivations into the dog's social behavior toward humans, such general explanatory constructions may conceal more by their sweeping generality than they reveal. Such interpretations may also serve to justify inappropriate and abusive training practices. Despite theoretical and empirical problems, Most's dominance theory of aggression is very popular, widely accepted, and sanctified by many respected authorities. In addition, although critical of Most's confrontational philosophy, many contemporary dog behavior consultants embrace the general theory that dogs *normally* form dominance hierarchies among themselves and parallel relations with humans—a system of social organization that determines "which animal has first access to food, resting places, and mates" (Uchida et al., 1997:397). The operative assumption is that dogs view the family as a pack and that they selectively exhibit aggression toward family members, depending on their perceived status. Accordingly, those individuals who are clearly dominant or submissive relative to the dog are believed to be at a significantly reduced risk of suffering an aggressive attack. Only those persons perceived as subordinates and who happen to challenge or confront the dog are at risk of evoking dominance-motivated attacks.

Although the term *dominance* is used with great alacrity and confidence as an explanatory construct, at a most fundamental level there is considerable confusion about what is meant by the idea. How does social dominance or rank order develop? What is the exact relationship between social dominance and aggressive behavior? Are dominance relations between humans and dogs of the same order as dominance relations between dogs? Is attack and threat antecedent necessities for establishing or maintaining social rank? These general questions and others need careful attention and delineation before an adequate understanding of the relationship between dominance and aggression is possible.

DEFINING DOMINANCE

Social dominance is often treated in the literature as a sort of intervening variable or organismic factor, mediating the expression of aggression under the influence of pertinent stimuli and contexts. In the case of dominance aggression, the attack is the dependent variable, and the various stimuli and contextual conditions under which it occurs represent independent variables. The putative intervening variable is *status* infringement. Other authors have variously described dominance in functional terms, as an emergent attribute or merely as a *post hoc* descriptor. Drews (1993) devised the following operational definition of dominance in order to avoid some of the common pitfalls:

> Dominance is an attribute of the pattern of repeated, agonistic interactions between two individuals, characterized by a consistent outcome in favour of the same dyad member and a default yielding response of its opponent rather than escalation. The status of the consistent winner is dominant and that of the loser subordinate. (308)

There is an important distinction being drawn by this definition: dominance is an attribute of a relationship, not an attribute of an individual animal. Indeed, it is hard to

speak of a dog as being dominant, except in relation to some other individual who is subordinate. In other words, dominance is not a personal or biological trait per se but a predictive inference based on a pattern of win-lose contests between two or more animals. The term *dominant* denotes a predictive assumption regarding the most likely outcome of any future competitive event occurring between two contestants. In terms of extremes, the dominance relationship can be termed *rigid* (implying a high probability to any prediction) or *fluid* (implying a low probability to any prediction). Most complex social organizations are structured around a *loose* dominance hierarchy, suggesting that the outcomes of most agonistic encounters are predictable but are not certain. Since dominance is not a trait belonging to an individual, but an *emergent* social attribute arising out of competitive interaction, it is not reasonable to speak of dominance as an inherited trait (Barrette, 1993). Although dominance per se may not be inherited, some characteristics (e.g., size and behavioral thresholds) conducive to competitive success may be heritable.

Many social animals appear to form dominance relations among themselves around situations tending to evoke competition, such as access to food, resting areas, and sexual privileges. For example, if two hungry puppies are presented with a food bowl big enough for only one of them to eat at a time, one of the pair will likely attempt to displace the other by threats or attack (if necessary) to secure exclusive control over the bowl (see *Learning to Compete and Cope* in Volume 1, Chapter 2). During similar future competitive encounters between the two puppies, the loser (now submissive) will tend to yield to the more aggressive winner (now dominant). Among puppies, dominance rank is established through active threats or attack but is subsequently maintained by the mutual exhibition and recognition of species-typical threat and appeasement displays. Social rank order is established to minimize social contests and prevent the outbreak of overt and potentially damaging fighting between competitors, thereby laying a foundation for social order and harmoniously organized group activity (Eibl-Eibesfeldt, 1979).

Structure of Dominance Relations

Schjelderup-Ebbe (1935) performed the first systematic studies of social dominance by observing the social exchanges between domestic chickens [see Wilson (1975) for an historical overview]. Chickens form *despotic* or linear *pecking* orders in which the most dominant chicken or *alpha* can peck at all other chickens without fear of reprisal. Ranked just below the top-ranking chicken in the pecking order is the *beta* chicken, who can peck at any other chicken in the group except the alpha, toward which the beta is subordinate. A similar relationship of dominant-subordinate relations is formed among the remaining individuals until a peck status or rank is assigned to all the chickens involved, with the least-dominant or omega chicken receiving pecks from all other chickens belonging to the group, while being unable to peck at any other chicken within the pecking order. In addition to pecking rights, dominant chickens enjoy various privileges associated with status, such as priority access to food and resting places. Also, dominant cocks exercise a sexual advantage over more subordinate competitors for mating privileges. An interesting finding noted by Schjelderup-Ebbe (1935) was that dominant chickens located further down the pecking order were more aggressive toward subordinates than was the alpha *despot* reigning at the top of the hierarchy. The trend toward reduced hostility in dominant chickens was found to occur when their status was improved after placing them into another flock:

> Often when a bird which ranks low in the pecking order in a flock comes to a higher position in another flock, the bird soon becomes strikingly milder in its conduct. If removed to the flock where it again stands low its harsh treatment of its subordinates once more appears. (963)

The linear pecking order is the simplest way in which a dominance hierarchy is organized within a group, but it is not the only

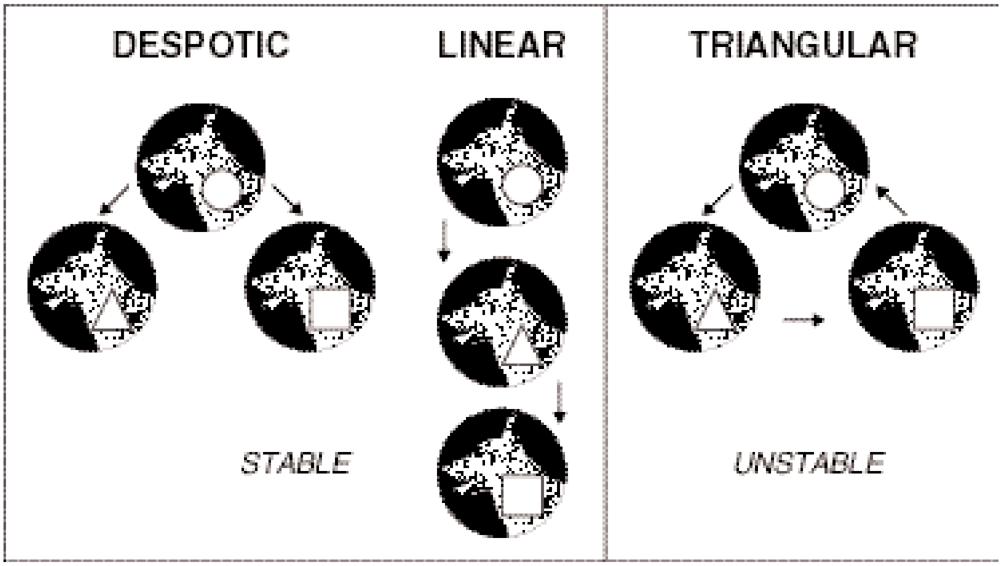

FIG. 8.2. Putative social relations from which dominance hierarchies are organized. Most dominance hierarchies are much more complicated, involving various alliances and contextual influences. After Wilson (1975).

way. In addition to despotic linear structures, triangular and other more complex nonlinear dominance hierarchies exist (Figure 8.2). Among wolves, social ranking is mostly nonlinear in structure (Rabb, 1967; Fox, 1973; Lockwood, 1979) (see *Social Dominance and Aggression*). Instead of a neatly defined hierarchy of status relations based on individual competitive success, wolf-pack social organization is affected by other less obvious *political* factors, such as kinship relations (dependent ranking) and various coalitions exerting pressures on the dominance structure.

In the human family situation, in addition to highly unstable triangular relations, parents may form a cooperative coalition under which influence a dog is subordinate, at least while both are present or when the most dominant of the two is present. However, if the less dominant of the two is left alone with the dog, the dog may assume a more dominant (that is, controlling) role. Frequently, a dog is submissive toward both adults but dominant toward children in the family. Ideally, a family coalition should be formed between the parents and children to secure *rank* over the subordinate dog (Netto et al., 1992). Dogs established midway in the dominance hierarchy (i.e., between adults and children) may behave in a way that parallels Schjelderup-Ebbe's intermediate-ranking chickens, becoming more vigilant and influenced by an enhanced aggressive readiness in relation to *subordinate* family members.

SOCIAL DOMINANCE AND AGGRESSION

To appreciate the role of social dominance as a factor in aggression problems, it is useful to examine some of the ethological findings derived primarily from the study of wolf behavior.

Threat and Appeasement Displays

Both dogs and wolves maintain peaceful social relations by exchanging various species-typical threat (dominant) and appeasement (submissive) displays. Schenkel (1967) has divided submissive displays into two general categories: active and passive. *Active submission* is characterized by increased activity levels and postural diminution, with the tail being carried in a variable carriage and ears held back or twisted in various expressive ways.

Such displays often include active fawning, nuzzling, and licking—*attention-seeking* behavior. Some dogs *grin* or clack their teeth, some may exhibit various pawing motions or crouch down in a play-soliciting bow, and others may crouch with a twist to one side or other, while scooting forward. The tail is often wildly expressive, waving in wide sweeping or whirling motions with the hindquarters moving from side to side. Active-submission displays are observed during greeting between the owner and dog, the dog often jumping up, attempting to push against or lick the returning owner upon his or her mouth—the apparent goal of such behavior (Trumler, 1973). Most so-called attention-seeking behavior by dogs is motivated by active submission. Passive submission is most frequently observed when threats are directed toward the subordinate by the dominant individual. Passive submission involves dramatic reduction of activity (a dog often freezes), averting eye contact, lowering of the head and body onto the ground, and sometimes concluding with a lateral recumbency and exposure of the ventral areas of the chest and the inguinal areas of the abdomen. The ears are pressed back with the tail tucked between the legs. Sometimes, passive submission is associated with submissive urination—an appeasement expression deriving from early reflexive elimination elicited by the mother's lingual stimulation of the anogenital areas (Fox, 1971).

In addition to visual and auditory information, olfactory signals may also play a significant role in communicating social status. Although not yet identified in dogs, releaser pheromones and other sources of olfactory information regulate the expression of aggression and submission in other mammalian species (Sommerville and Broom, 1999). Under intense aversive stimulation, a release of anal sac contents or defecation may occur. Anal secretions may contain chemical or pheromonal alarm signals capable of inhibiting aggression or, perhaps, serving as a chemical-repellent defense aimed at distracting or turning the aggressor away from the attack. Analysis of the pheromonal contents of anal gland secretions [see Preti et al. (1976)] and their various potential effects on canine behavior may be of significant value, especially with respect to potential antiaggression properties. If found to exert such effects, synthetic-scent homologues could be produced that might offer therapeutic as well as practical benefit as humane inhibitors/repellents for the control of aggressive behavior.

Dominance displays involve various threatening gestures and postures. Low-level threats include a dog standing over or assuming an agonistic T orientation toward its owner or another dog. The dog may rest its head over the opponent's shoulders and proceed to ride up on its back before launching into an attack. Some dogs may grab the skin of the neck (scruff) or attempt to control the opponent's muzzle, especially in the case of adult dogs disciplining puppies. Other dominant displays include body bumping and hip slamming, sometimes forceful enough to knock the opponent off its feet. During displays of increasing threat, a dog's center of gravity appears to shift forward with a stiffening of the body and front legs. Characteristically, a dominant dog sets up squarely facing its opponent and maintains direct eye contact or agonistic stare while poised in a state of increasing readiness: ears are up and turned forward, and its body appears swollen as the result of muscular stiffening and piloerection extending from the neck down to the rump. An aggressively aroused dog may appear to walk on its toes, with the tail carried high and its tip rising above the horizontal line of the back. As the threat escalates, the tail may be held stiffly erect or wagged in short rapid arcs. Just before launching into an attack, the dog may exhibit a threatening growl, snarl, widely bare its teeth by retracting the upper lip up and back (defensive display) or by showing an *agonistic pucker* formed by drawing the commissure of the upper and lower lips forward, thereby wrinkling the muzzle and exposing the teeth (offensive display).

Finally, some dogs may exhibit various equivocal or ambiguous signs, such as pawing the owner, leaning on the owner, placing a paw on the owner's foot, mouthing the owner, jumping up in persistent efforts to get up onto the owner's lap, and obnoxious licking efforts in spite of consistent discouragement. These various behaviors are most often associated with active submission or appease-

ment but may be used manipulatively to control the owner—efforts referred to as *obnoxious submissiveness.* Various forms of passive resistance may also be used by dogs in an effort to control the owner's actions. These sorts of behaviors can be problematic to correct with punishment, since by doing so they may become worse. Often a combination of instrumental counterconditioning, extinction, and time-out works well to control such behavioral excesses.

Peace-making Theory of Social Dominance

An important goal of dominance relations and the acceptance of dominant and subordinate roles by group members is the maintenance of group harmony and peace. When Lockwood (1979) performed a factor analysis of behavioral and physical traits correlating with dominance status among wolves, he found that the number of threat displays exhibited by pack members showed a low correlation with respect to relative dominance or rank. In other words, dominant wolves are not distinguished by the overall number of threats they exhibit toward other pack members. Of course, dominant individuals are quite capable of asserting and defending their status but do not lightly flaunt their power or engage in superfluous challenges or troublemaking within the pack. Although the initiation of dominance threats was not a significant measure of social status, several other characteristics and traits were found to be correlated with social rank: a high degree of success at controlling food access, heavy body weight, reception of a large percentage of submissive behavior displayed by conspecifics, and a high frequency of scent-marking activity.

Van Hooff and Wensing (1987) have confirmed many of Lockwood's general findings, observing that the most reliable measure of relative status is postural indicators exhibited by interacting wolves. Dominant wolves present themselves in taller postures relative to subordinates, whereas subordinates present themselves to dominant counterparts in postures that accentuate their smallness. Consistent with Lockwood's observations, Van Hooff and Wensing found that threatening or assaultive behavior was only moderately correlated with dominance, concluding that such behavior may actually belong to a separate behavioral category.

Dominance versus Deference Hierarchy

Although the term *dominance* typically denotes a social relationship based on a regular exchange of species-typical threat and appeasement signals between at least two individuals, the evidence provided by Lockwood and by Van Hooff and Wensing suggests that social rank is not solely or even primarily maintained by threat initiatives exhibited by dominant individuals. For the most part, the dominant animal, or *alpha,* refrains from asserting gratuitous displays of rank, so long as its social priority is recognized and respected by subordinates. Instead of depending on the initiation of threats by the alpha toward subordinates to maintain the group's social hierarchy, such relations appear to be primarily maintained by the deferential active and passive-submission behaviors exhibited by subordinates toward the group leader. Viewed from this perspective, the structure may be more appropriately described as a *deference* hierarchy rather than a dominance hierarchy (Rowell, 1974). According to this notion, the alpha is likely to exhibit dominance threats, only under circumstances in which its status or privileges are disputed, rather than going about unnecessarily challenging and testing subordinate group members. The alpha presumes their subordination, unless they exhibit behavior indicating otherwise. As a general rule, the pack is a peaceful organization, with the highest-ranking individuals being only infrequently involved in serious competitive strafes.

Dominance and Social Harmony

Dog social behavior has often been interpreted and misinterpreted in terms of wolf behavior. Although an alpha wolf is not above an occasional arbitrary assertion of power, a wise lupine leader avoids unnecessary dominance contests and assertions of authority. The establishment of dominance status does not necessarily depend on aggressive competi-

tion. Fonberg (1988), for example, found that dominance is often established without any overt exchange of aggression or obvious physical indications of physical superiority. She notes that dominance established without resorting to aggression appears to be more stable than dominance maintained by constant vigilance and display of strength. Instead of relying on force and threat to maintain control, an alpha's authority depends on other group members actively recognizing and deferring to its status and role as their leader. There appears to be a genuine wisdom in this arrangement, since a more intrusive style of control would run the risk of producing unnecessary and disruptive *dominance tensions* within a group. Also, it is not by accident that so many active and passive-submission behaviors in wolves and dogs are also used to express affection. In fact, submissive displays appear to be a composite of fearful and affectionate elements—belying the affiliative origins of such behavior. Affectionate submission reinforces an alpha's status, makes it feel secure in its position of control, facilitates group cohesion and cooperation, and promotes social contentment and well-being.

An alpha's ritualized expressions of dominance, social distancing, and aloofness all encourage a flow of social affection in its direction, thereby consolidating its leadership by popular opinion. The pack follows its leader, not so much out of fear or compulsion, as from a natural attraction and desire to stay in close proximity with an object of affection. Besides facilitating leadership, affection in wolves and dogs is a natural inhibitor of aggressive behavior. The more affection exhibited by subordinates toward their leader, the more secure, peaceful, and lasting its reign of control is likely to be. Although repeated assertions of dominance may reinforce passive submission, such efforts also close social distance and evoke competitive tensions and fear in subordinates. In situations of high levels of such aggressive interaction, one would expect to observe increased agitation, protest, and a greater likelihood of actual fighting.

As long as dominant-subordinate relations are clear-cut, affectionate harmony will properly characterize the interaction of pack members. Disruptive dominance tensions develop as the result of poor leadership (incompetence) and increased competition between the leader and subordinates. Such competitive interaction has a pronounced influence on the social stability and contentment of the group. Since *only near equals compete,* when excessive competition occurs it signals a narrowing of relative dominance between the leader and subordinates. The direct outcome of competitive interaction is a reduction in affectionate inhibitions and the expression of defiance and aggressive threat by challenging subordinates. During such competitive challenges, the alpha is forced to assert its privilege of rank by escalating aggressive threats toward the disaffected subordinate, which may in turn either submit or counter the alpha's threat with an aggressive counterthreat of its own. At such times, an overt and damaging fight might break out, unless the subordinate submits.

The maintenance of social distance and aloofness plays an important role in the prevention of such tensions. By staying apart and establishing clear symbolic boundaries and limits, an alpha effectively prevents such disruptive agonistic tensions from occurring. When such social boundaries are absent or undefended, the likelihood of competitive tensions and aggression is correspondingly increased. A leader wolf protects its rights and privileges but does not casually intrude on the rights and privileges of subordinates. Even the lowest-ranking subordinate will defend a bone or a piece of food that it has managed to secure for itself. Only a rather incompetent leader would go about challenging and agitating deferential subordinates. In short, the process of maintaining dominance is about regulating social limits and boundaries while making oneself an object of social attention and affection—a leader.

A completely stable group without aggression may not be possible, however. Reportedly, under stable social conditions where agonistic behavior is rarely expressed, aggressive energy may actually *build up* over time, causing the alpha wolf finally, and without much warning or provocation, to attack the omega (lowest) member of the group spontaneously. This sort of aggressive expression has been termed *energy displacement* activity and may represent an adaptive release mechanism controlling the

buildup of aggressive energy, perhaps preventing a more disruptive and damaging outburst (Mech, 1970). This general theory, especially in the form of Lorenz's (1966) *psychohydraulic model* of aggression, has been widely criticized. Lorenz argued that aggression reflected the operation of an underlying instinct or appetite for fighting. According to his theory, aggression is a motivated by a drive similar in nature to hunger and thirst. He believed that *aggressive energy* accumulates over time, eventually compelling the animal to seek a suitable object upon which to *vent* its aggressive energy. If a species-typical object is not available, the animal may express the aggressive energy in the form of vacuum behavior, perhaps attacking under inappropriate situations or displacing it upon inappropriate objects. Lorenz believed that aggressive energy builds up according to the biological needs of the species, causing some animals to show a greater aggressive drive than others. Others have theorized that social aggression is primarily the result of the inevitable frustration that accumulates as the result of interacting with others competing for the same resources or interfering with one's goal-seeking activities. For example, Dollard and colleagues (1939) argued that "aggression is always a consequence of frustration" (1). Frustration is defined by them as any interference in the performance of goal-seeking activity. Calhoun [see Papero (1990)] describes a similar tendency toward an acquired propensity for aggression as the result of social interaction, but interprets it in terms of a need for the attainment of psychobiological balance between frustration and gratification. According to this theory, under social conditions in which an individual receives too many *gratifying* experiences, it will deliberately seek to trigger agonistic episodes to achieve a more satisfying balance between frustration and gratification. Social contentment is achieved by balancing gratifying and frustrating experiences.

Dominance or Pseudodominance

Many authorities have commented on the degenerative effects of domestication on the social behavior of dogs. In comparison to the robust social dominance and submission rituals exhibited by wolves, the corresponding agonistic behavior patterns in dogs have "disintegrated into an assortment of independent behavioral fragments" (Frank and Frank, 1982:519). Although a dog's social reality is strongly influenced by its wolf-genetic heritage, it is hard to describe faithfully the human-dog relationship in terms of the wolf model of social rank. For one thing, the human-dog relationship is often much more equivocal and complex than captured by the concept of social rank. It is also filled with considerable confusion with respect to the meaning of specific social exchanges between people and dogs and how they should be interpreted.

Most social transactions between people and dogs appear to be organized around playful attention-seeking (active submission) exchanges and following patterns, rather than true dominant-subordinate relations based on the purposeful exchange of threat and appeasement (passive submission) displays. Among highly sociable dogs with elevated fear and aggression thresholds, the impulse to challenge their owners for dominance with a sincere threat or contest probably never passes through their minds. Although not feeling very dominant toward their owners, such dogs probably do not feel very submissive or subordinate either. In such cases, the appearance of competitive tension may simply be the net result of frustrating playful exchanges having little ulterior motivation, being nothing more than play for the sake of play and the immediate pleasures produced by the activity. Fun-loving dogs might get themselves into constant trouble as the result of their playful antics and teasing games, become attention-seeking pests, or possibly form an excessively strong attachment with an overly indulgent owner, but such dogs are unlikely to launch a serious dominance challenge against the owner, except in the most playful and obnoxious sense of the word. In such cases, the appearance of social competition is better described as sham or pseudodominance.

Dominance: Status or Control

Aggression directed toward the owner often occurs as the result of competitive or threatening interaction with the dog. Dogs resort to

aggression as a means to establish control over motivationally adverse circumstances generated by the owner. Depending on a dog's success or failure, it may adopt a dominant or subordinate role in relation to its owner and consequently be more likely to threaten or defer to the owner under the influence of similar circumstances in the future. The original causes of aggression are competition or threat, occurring under the influence of loss, discomfort, disturbance, or interference. Under such circumstances, a dog is variably aroused with frustration, anger, or irritability—*establishing operations* that render aggression more likely and provide the motivational bases for its subsequent reinforcement or punishment. If the behavior succeeds, the victim's various gestures, postures, and contact activities present at the time of the attack may be learned as discriminative stimuli controlling future aggressive efforts, especially when the dog is exposed to similar competitive or threatening circumstances. Also, the owner's actions present at the time of attack (approaching, reaching for, or leaning over) may function as conditioned establishing operations (triggers), setting the motivational occasion for the dog to respond aggressively with some expectation of success.

With repeated exposure to such situations, the behavioral thresholds controlling aggression may be lowered, while thresholds regulating the expression of fear may be gradually elevated. These combined motivational influences may cause a dog to become more confident and assertive. As a result, the likelihood of aggression may increase, with its magnitude progressively becoming more vigorous and damaging—all changes occurring as the result of social learning and the alteration of conditioned triggers regulating fear and aggression. If punishment is attempted at such times, the dog's aggressive control efforts may escalate—now intensely invigorated by frustration and rage. If a dog's control efforts are successful, its agonistic behavior may fall under the motivational influence of an additional species-typical incentive: the securement of rank and status. Consequently, the dog may expect its owner to recognize its dominant status and play a submissive role by showing appropriate appeasement and deference behavior in response to its threats. Further, the dog may become progressively intolerant of intrusion (e.g., while sleeping or eating), resent routine control efforts (e.g., grabbing the dog's collar), and react aggressively toward disciplinary actions carried out by its owner.

Dominance aggression often involves very severe attacks that occur under minimal or no apparent provocation at all—characteristics that nicely fit the control-learning hypothesis and analysis of dominance aggression. The notion of *status* is inextricably bound up with learning and conditioning. Although the recognition and display of status appear to play a significant functional role in the organization of dog social behavior and the maintenance of dominant-subordinate relations, most dominance aggression appears to be the result of social confusion, frustration, irritability, contact aversion, and learning. Rather than being socially dominant, many dominance aggressors simply appear to be socially *incompetent* and unable adaptively to navigate the social and interactive demands placed upon them without biting. In the vast majority of cases involving aggression (Borchelt and Voith, 1986, 1996), the behavior appears to be mostly related to control interests, operating under adverse motivational circumstances involving heightened anger, frustration, or irritability. Although there are many situations in which social status may become a significant factor, aggression is primarily grounded upon control-related efforts. Status and status-related aggression come about as the result of a history of success in threatening or attacking the owner. Essentially, status-related aggression is the conditioned outcome of a history of successful aggressive control efforts.

Locus of Control and Social Attention

The nature of social dominance has been analyzed in a variety of ways. A general characteristic of dominance is locus of control, that is, the initiation of significant social activities. Among wolves the leader is usually responsible for initiating and guiding vital group activities, such as hunting sorties, territorial and group protection, and reproduction. A related notion is focus of attention. Dominant animals appear

to attract and control the most attention from group members (Chance, 1967). During greeting displays, for example, the alpha male and female wolf are the object of intense interest and activity. A dog's ability to initiate and control activities and to hold its owner's attention offers interesting possibilities for understanding the notion of pseudodominance. Many pseudodominant dogs express an almost compulsive drive for attention and social recognition. The attention-controlling behaviors involved are frequently of a highly competitive nature (although playful and nonescalating) and are often conflated with hyperactivity. Many of the *games* involved are competitive, involving various taunts and challenges aimed at provoking a response in the owner (Voith, 1980a,b). In many ways, pseudodominant dogs are simply obnoxious subordinates who have not been properly trained to respect appropriate social boundaries.

Schenkel (1967) offers a pithy observation in this regard among wolves: "If the superior is tolerant but fails to display his superiority, the inferior may behave obtrusively" (325). A favorite, rather dominant, attention-controlling game is the familiar "steal a forbidden item and run like hell" routine, thereby evoking an episode of "catch me if you can, stupid" throughout the house. In general, the behaviors involved are designed to maximize the amount and direction of attention toward the dog in a manipulative and controlling mode of interaction. Many other nuisance behaviors fall under this general category, including playful biting at hands and feet, excessive barking, jumping on furniture and guests, pestering antics of various kinds, and other expressions of opportunistic mischief.

Pseudodominant dogs enjoy making a focus of themselves during social encounters and are not adverse to putting on a show for any audience willing to play the role of subordinate *victim.* Dogs that persist in such obtrusive and unwanted behavior, including provocative chase episodes, the initiation of aggressive tug of war games, and rough, uncontrollable play, are expressing a high degree of social competitiveness—a pattern of interaction that may introduce the seed for more serious problems (Netto et al., 1992).

INTERSPECIES SOCIAL DOMINANCE

Harmonious social interaction between people and dogs appears to depend on the establishment of a leader-follower bond. This need is well recognized by most dog behavior authorities and dog owners. A dog's readiness to meet the demands of domestic life is only half provided by its biological predisposition; the other half is provided by the actualizing effects of socialization and training. Without the guidance of a competent leader, a dog's social adjustment may suffer irreparable damage. Although we may sometimes imagine that dogs understand and appreciate our foibles and values, they do not; nor do they appreciate the full consequences of their behavior from our all-too-human perspective. William James (1896/1956) eloquently describes the situation:

> Our dogs, for example, are in our human life but not of it. They witness hourly the outward body of events whose inner meaning cannot, by any possible operation, be revealed to their intelligence,—events in which they themselves often play the cardinal part. My terrier bites a teasing boy, for example, and the father demands damages. The dog may be present at every step of the negotiation, and see the money paid, without an inkling of what it all means, without a suspicion that it has anything to do with him; and he never can know in his natural dog's life. . . In the dog's life we see the world invisible to him because we live in both worlds. In human life, although we only see our world, and his within it yet encompassing both these worlds a still wider world may be there, as unseen by us as our world is by him; and to believe in that world may be the most essential function that our lives in this world have to perform. (57–58)

Konrad Most (1910/1955) echoes these same sentiments:

> We credit him with capacity for thought and with an understanding of human behavior and morality. By introducing the dog into a world which is, in reality, forever closed to him, we prevent ourselves from recognizing the unbridgeable mental gap that exists between man and dog. (3)

As a result of these inherent limitations, a dog's adaptation to domestic life must be con-

stantly guided and shaped by human intervention and training. Suppose for a moment that the relationship was in reverse, and we as infants were cast into the midst of a kindly pack of wolves and somehow managed to survive the ordeal. Consider how confused we would be by their customs and manner of doing things. We would never really have a clue but would nonetheless gradually adjust to the natural contingencies of reward and punishment provided by the situation (or perish). A major difference between a dog's fate and this hypothetical one is that we can serve a dog's interests and assist in its adaptation by becoming a rational proxy for it in this strange world, guiding the dog's choices until it is adequately socialized and trained to make the correct choices on its own. To accept our leadership, a dog must adopt a submissive and cooperative attitude at a very early stage in its development and remain that way for the rest of its life. The majority of dogs appear to defer to human leadership instinctively; all that is needed for success is an owner who embraces his or her responsibility and takes control. A puppy's affectionate and dependent attachment is an expression of its natural inclination to submit to our guidance. A dog's sense of security and well-being depends on its owner recognizing these needs and satisfying them with adequate socialization and training.

Avoiding a persistent "ritualization of confusion" arising from mixed messages and misunderstanding between the owner and dog begins with the establishment of clear and definitive social boundaries. Defining oneself as a leader is accomplished by defending social limits (e.g., not permitting the dog to jump up, to bite on hands or clothing, or to pull on the leash), maintaining appropriate social distance, and developing a cooperative relationship based on gentle compliance training and directive measures, when necessary. As a result of such efforts, the dog will naturally become increasingly affectionate and cooperative. Leaders avoid engaging dogs in unnecessary contests of will, but when their authority is challenged, they provide immediate and definitive actions that leave no room for doubt about where they stand on the matter. On the other hand, leaders recognize and reciprocate cooperation with affection and other attractive consequences. Directive actions are mostly used as a means to defend an infringed social boundary, rather than as a routine means for compelling obedience. Once these necessary preliminaries are settled, instructing a dog becomes an easy and enjoyable task because it is oriented toward the trainer as an affectionate and subordinate follower. Once basic social boundaries are established, other behavioral objectives are rapidly achieved by differentially presenting or omitting rewards, such as affection, food, play, and other activities and resources that the dog may desire to obtain.

Aside from a failure of owners to establish themselves as leaders, dominance-control tensions often evolve as the result of ineffectual disciplinary interaction or interference. As evident by their desire for human contact, most dogs are innately submissive to their owners; even in cases where the owners may fail to play a satisfactory and consistent leadership role, their dogs remain affectionately submissive. But sometimes such neglected dogs may become progressively intolerant and aggressive toward the owner's efforts to control them. Many dominance-related problems appear to stem from dominance tensions produced by the owner's habitual and ineffectual efforts to control the dog's behavior. From an early age onward, dogs are exposed to repeated and ineffectual efforts to control or punish them. The problem is compounded when, failing to secure a dog's compliance, the owner simply gives up or clumsily enforces his or her demands. As a result, the dog may become progressively competitive, resistant, difficult, and intolerant of control. Several other negative side effects may ensue from this pattern of interaction:

1. The owner and dog become locked in a pattern of unresolved competition.
2. The stabilizing social distance between the owner and dog becomes progressively narrowed or obliterated.
3. Unresolved dominance conflicts and tensions increase the dog's frustration and irritability while simultaneously rendering it less submissively affectionate and tolerant toward the owner.

Dominance-control tensions and frustration may accumulate as the result of such interaction, until at last a point is reached where a dog becomes intolerant of its owner's irritating or frustrating interference and infringements on its *space.* As the dog becomes more confident and overtly aggressive, its affection and tolerance for contact with the owner may suffer diminishment, as well. It should be noted, however, that many dominance aggressors are highly affectionate toward their owners and may only become intolerant of contact under the influence of specific situations. Upon reaching social maturity, the dog may become progressively aloof, distant, irritable, and resistant to control. If these attitudinal and behavioral changes are not checked, the dog may come to view its owner's efforts to control it as provocative threats. The dog may resort to aggression in an effort to counter the owner's control efforts and to set social boundaries between itself and its ineffectual owner. If the dog does bite, the aggressive actions are likely to go unpunished. Most owners at this point simply back off in shock, only to return later to *reach* the offending dog with placative bribes of affection and food, thereby making matters worse by playing the affiliative role of the subordinate.

Even more potentially damaging, some owners may attempt to punish the behavior, causing the dog to redouble its aggressive efforts, under the escalating influence of pain, fear, and anger. If the dog succeeds in defending itself or perceives that it has controlled the situation by resorting to aggression, it will tend to resort to such behavior under similar circumstances in the future. To defend itself most effectively, the dog may adopt a highly vigilant attitude and learn to react preemptively to previously neutral stimuli associated with such punitive situations—avoidance-motivated aggression. In addition, internal stimuli associated with such provocative situations may trigger establishing operations that prepare the dog to behave in a threatening manner and raise the likelihood that such behavior will undergo significant reinforcement if it succeeds.

According to the foregoing analysis, the dog exhibits aggression because such behavior succeeds in controlling the owner-target. The intrusive actions of the owner function as conditioned establishing operations, triggering motivational changes conducive to the emission of aggressive behavior and setting the stage to reinforce the aggressive behavior strongly, if it succeeds. Reinforcement occurs when the owner is displaced by threat or attack, simultaneously reducing aversive aggressive arousal and replacing it with emotional relief and elative feelings of enhanced well-being and control.

SOCIAL DISTANCE AND POLARITY

Many dominant-aggressive dogs tend to be rather reserved with their affections, often being affection receivers rather than affection givers. Although affection can be a strong inhibitor of aggression (see below), its inhibitory effect depends on the direction of affection, that is, its *polarity.* The subordinate affection giver is much more inhibited about behaving aggressively toward the dominant object of affection than the dominant affection receiver is toward the giver of affection. Fear toward the object of affection is often irrationally suppressed in the affection giver, as is evident, for instance, in the case of an abusive human relationship involving physical battery. This effect is also present in the persistent affection and lack of appropriate fear exhibited by some owners of dominant-aggressive dogs.

A subordinate is urged on by social attraction to stay in relatively close proximity with the leader, an attraction that may paradoxically increase with repeated exposure to the alpha's threats and subsequent reconciliation. The growing leader-follower bond serves both to reduce the future likelihood that the subordinate will challenge the leader and may simultaneously increase the leader's tolerance for contact with the deferential and affectionate subordinate. In both cases, the risk of aggression is decreased by affection; that is, affection reduces the likelihood that the subordinate will act aggressively toward the leader, while the reception of affection renders

the leader more tolerant of contact with the subordinate. This ideal arrangement of reciprocal inhibition is not always evident, however. Many dominant dogs appear to be intolerant of contact, even affectionate contact. In such cases, increased affectionate interaction does nothing to encourage tolerance but may, on the contrary, increase intolerance. The effect is analogous to unrequited love between humans, where the lovesick suitor persistently seeks the attentions of a lover, even though the efforts are repeatedly scorned and punished. Although affection is normally highly desirable and conducive to tolerance and reciprocation, under such circumstances the persistent efforts of the suitor (affection giver) may become highly aversive to the object of affection.

The direction of social polarity and attention reflects the cumulative outcomes of agonistic and affiliative exchanges, with affection and attention-seeking behavior (active submission) moving primarily from the subordinate toward the alpha. Social polarity, based on affectionate submission, provides the foundation for orderly group cooperation and organized activity. Early social dependency involving the reception of nurturance and protection gives way to more mature social relationships based on emergent social status and the formation of a leader-follower bond. In essence, social polarity provides a motivational substrate for mediating social stratification and organizing leader-follower roles.

Reversing the direction of social polarity through integrated compliance training, whereby the reception of affection and other rewards is made contingent on subordinate behavior, offers a useful management technique in the treatment of dominance aggression. As a preliminary to such training, dominance aggressors are often ignored for several days until they seek out the owner's contact and actively solicit affection—affection that they must now learn to earn (Campbell, 1992). This may be a very hard recommendation to implement by owners who are profoundly attached to their dogs and unwilling to exchange the immediate pleasures of doting affection for the delayed therapeutic benefits of social distance and integrated compliance training, that is, owners who are unable to make themselves leaders worthy of canine affection and respect. The power of the *cold shoulder* for managing dog behavior was first reported by George Romanes (1888). The anecdote describes a Skye terrier that had decided with strong aggressive protests not to accept its bath anymore. The owner of the dog happened upon the strategy of withdrawing affection. The effort took several days, but the dog finally relented and accepted her control:

> "In process of time this aversion increased so much that all the servants I had refused to perform the ablutions, being in terror of doing so from the ferocity the animal evinced on such occasions. I myself did not choose to undertake the office for though the animal was passionately attached to me, such was his horror of the operation, that even I was not safe. Threats, beating, and starving were all of no avail; he still persisted in his obstinacy. At length I hit upon a new device. Leaving him perfectly free, and not curtailing his liberty in any way, I let him know, by taking no notice of him, that he had offended me. He was usually the companion of my walks, but now I refused to let him accompany me. When I returned home I took no notice of his demonstrative welcome, and when he came looking up at me for caresses when I was engaged either in reading or needlework, I deliberately turned my head aside. This state of things continued for about a week or ten days, and the poor animal looked wretched and forlorn. There was evidently a conflict going on within him, which told visibly on his outward appearance. At length one morning he quietly crept up to me and gave me a look which said plainly as any spoken words could have done, I can stand it no longer; I submit. And submit he did quite quietly and patiently to one of the roughest ablutions it had ever been his lot to experience; for by this time he sorely needed it. After it was over he bounded to me with a joyous bark and wag of his tail, saying unmistakably, 'I know all is right now.' He took his place by my side as his right when I went for my walk, and retained from that time his usually glad and joyous expression of countenance. When the period for the next ablution came round the old spirit of obstinacy resumed its sway for a while, but a single look at my averted countenance was sufficient for him, and he again submitted without a murmur. Must there not have been something akin

> to the reasoning faculty in the breast of an animal who could thus for ten days carry on such a struggle?"
>
> This strong effect of silent coldness shows that the loss of affectionate regard caused the terrier more suffering than beating, starving, or even the hated bath; and as many analogous cases might be quoted, I have no hesitation in adducing this one as typical of the craving for affectionate regard which is manifested by sensitive dogs [Romanes's comment]. (440–441)

This nice anecdote underscores the efficacy of affection-attention withdrawal for reversing social polarity and enhancing relative dominance.

Despite the ethological appeal of the social polarity hypothesis, it needs to be stressed that the presence of active affection and solicitation of attention is not necessarily a sure indicator of a dog's intention and the risk of aggression. Some dominance aggressors appear to be highly affectionate and excited about contact, only to bite when the owner handles them in the wrong way. Some may enthusiastically greet visitors with intense displays of apparent affection and attention giving, only to bite them as they become more familiar and they attempt to pet or hug them. Others may make themselves the center of affectionate attention and remain nonaggressive, at least until the visitor (or family member) gets up to leave the house. The role of affection and attachment in dominance aggression is complex, and the foregoing is offered as a tentative hypothesis. Perhaps, dogs that show what appears to be authentic affection and attention giving but, nonetheless, bite under the influence of minimal provocation (e.g., upon being petted) are truly of a sociopathic order. In such a case, attention and affectionate displays may be offered in the absence of sincere submissive intentions and other social implications that one might be given to expect. Like the human sociopathic aggressor, the canine sociopathic aggressor may lack true empathy and feeling and more or less *feign* affection and submissive sociability, thereby concealing an aggressive potential. Interestingly, such dogs are often distinguished by an intolerance for frustration and an inability to engage in fluid *give and take* competitive play.

AFFILIATION AND SOCIAL DOMINANCE

An important aspect of group organization is the exchange of affection and the development of affiliative behavior. In addition to offsetting and balancing tensions generated by competitive interaction, social exchanges involving affectionate behavior encourage group cohesion and identity. The importance and function of affiliative bonding between aggressive group members have been emphasized by Lorenz (1964):

> Indubitably, ritualized aggressive behaviour is at least one root of bond behaviour. . . . There may be other independent ways in which bond behavior has evolved, but wherever it did, it seems to have done so as a means of controlling aggression, that is to say on the basis of aggressive behaviour preexisting. In the Canidae for instance, in the dog-like carnivore, all gestures and ceremonies of greeting, love and friendship are obviously derived from the expression movements denoting infantile submission. . . . The strongest reason, however, which makes me believe that all bond behaviour has evolved, by way of ritualization, on the basis of intraspecific aggression, lies in an unsuspected correlation between both. We do not know, as yet, of a single organism showing bond behaviour while being devoid of aggression; in a way, this is surprising, as, at a superficial appraisal, one would expect bond behaviour to evolve rather in those highly gregarious creatures which, like many fish and birds, live peacefully in large schools or flocks, but this obviously never happens. . . . Also, there seems to be a strong positive correlation between the strength of intraspecific aggression and that of bond behaviour. . . . No more faithful friendship is known in this class than that which S. Wahburn and I. De Voore have shown to exist among wild baboons, while the symbol of all aggression, the wolf, whom Dante calls the "bestia senza pace" has become "man's best friend," and that not on the grounds of properties developed in the course of domestication. (47–48)

Without a strong social bonding tendency and sense of affiliation, reinforced through species-typical socialization patterns and affectionate exchange, the disruptive effects of agonistic interaction would gradually disperse pack members and destroy the family/pack group. In other words, hierarchically organ-

ized animals appear to *love* one another in spite of their ritualized and sometimes fierce competition. Without affection, the social order would rapidly disintegrate into a chaos of disorganized self-interest and individualism. According to Schenkel (1967), among wolves feelings of belonging such as love and intimacy are acquired in the context of forming dominant-subordinate relations:

> There is no doubt that submission is an appeal or effort to friendly social integration, to which the response by the superior is not stereotyped or automatic. Only if the superior, too, is motivated to enter into friendly contact with the inferior, will harmonic social integration really take place. If he responds with non-tolerance, the inferior will not persist in submission. Both components of submission, namely inferiority and "love," can only exist if they meet "generosity," i.e., superiority combined with tolerance or tolerant "love." Both the superiority-inferiority relation and the atmosphere of "love" and intimacy do not rely on automatic responses but are shaped in the social contact as components of "personal" interrelationship. (326)

A representative expression of such group affection is observed in the canid greeting ceremony—an active-submission pattern exhibited by both wolves and dogs. Among dogs, the licking toward the face, presumably done by puppies to elicit regurgitation, is progressively transformed through developmental stages into an appeasement gesture and, ultimately, into a profound expression of canine affection and intimacy.

Affection and Competition

The social behavior of dogs is driven by two antagonistic motivational incentives: affiliation and competition. These complementary interests serve to establish a highly bonded and well-organized family/pack unit. Under normal conditions, these two social motivational systems mutually regulate each other to maintain group order and cohesiveness. In situations where either affiliation or competition oversteps appropriate bounds, one would expect to find corresponding disturbances in the group. For example, without the countervailing effects of affection and affiliative bonding, agonistic behavior would tend to disrupt the normal functioning of the group. Further, in the absence of affection, growing agonistic tensions would gradually disperse group members and destroy the group. Conversely, an excess of affiliative bonding and affectionate restraint would limit beneficial competition, thus preventing the formation of a dominance hierarchy. A group without internal competition and a viable dominance hierarchy would lack effective order, structure, and direction—potentially becoming an amorphous and ineffectual agglomerate of aimless individuals.

An important function of affection and affiliation is to facilitate interactive harmony and tolerance among group members. A few general predictions can be formulated concerning the relative effects of affection and aggression on the organization of canine social behavior. In cases where affectionate bonding is lacking, agonistic behavior should increase along several dimensions. Conversely, as affectionate bonding is rendered more secure and reliable, the incidence of aggressive behavior should correspondingly decrease in frequency and magnitude. Under conditions in which affectionate leader-follower bonding is prominent, one should expect to find increased attention turned toward the owner and a greater willingness for the dog to engage in cooperative behavior. However, in cases where affiliation and affection are conflicted motivationally with excessive frustration and irritability, perhaps as the result of dysfunctional interaction or an absence of leadership, the likelihood of social tension and aggression is increased.

Contact Aversion and Aggression

If affection and affiliative bonding modulate agonistic behavior, how does one explain the appearance of dominance aggression in situations where affectionate interaction between the owner and dog is not lacking? To begin with, although affection giving may foster a strong attachment between the giver-and-receiver dyad, it need not necessarily facilitate affiliative bonding between them (Scott, 1991). Bonding is distinguished from attachment by the presence a shared exchange based on affection, cooperation, and trust. One can

form an object attachment to a place, a thing, or an animal without necessarily forming an affiliative bond with it. A bond implies a two-way exchange, whereas an attachment may form and operate in one direction only. Many dog owners form object attachments with their "pet" dogs but fail to form an adequate bond with them. Gratuitous affection may be highly gratifying for the owner to give but be resented by the receiving dog. In some cases, affectionate overtures by the owner may be received by the dog as tactile agitation and interference, resulting in increased irritability and frustration. In other cases, affectionate interaction may be perceived as a threat or source of discomfort. For example, picking up, hugging, and patting a dog may not be perceived by it as a particularly pleasurable or welcome activity. Further, not all dogs enjoy being petted, especially when the petting is delivered by insensitive and clumsy hands. Although a dog may passively accept unsolicited affection, it may gradually become emotionally distressed and resentful of such contact. Thus, what an owner intends as affection may not be received by the dog as affection at all, but rather experienced as an annoyance—an irritating and frustrating annoyance. As the result of unwelcome affection, such dogs may become progressively intolerant of petting or handling and finally act out aggressively to establish social distance.

In summary, some dogs may resent affectionate contact and only tolerate such interaction under clinched teeth. Unwelcome affection may be a significant source of irritability and frustration for such dogs. According to Panksepp (1998), frustration and anger are closely associated in the psychobiology of animals:

> Is the feeling of frustration really substantially different than that of anger? Psychobiological evidence certainly allows us to conclude that they are intimately linked, since manipulations that reduce the effects of frustration, such as antianxiety agents and temporal lobe damage or more restricted amygdaloid lesions, also tend to reduce emotional aggression. Thus, the emotional feeling of frustration may largely reflect the mild arousal of RAGE circuitry, in the same way that anxiety may reflect weak arousal of FEAR circuitry. (192)

If frustration is experienced by a dog as low-grade rage, over time and repeated exposure, the accumulated frustration and irritability arising from unwelcome social contact may gradually lower relevant rage-response thresholds controlling the expression of overt aggression. A contact-aversion interpretation fits a number of the facts associated with dominance aggression:

1. Aggression is often selectively directed.
2. Aggression often takes place in areas associated with affectionate activity (e.g., on sofas and beds).
3. Aggression often occurs under the influence of minimum stimulation, such as when the dog is being reached for in a nonprovocation way.
4. Aggression is often explosive and inappropriate, suggesting an accumulated tension building up over time.
5. Dominance aggressors may become progressively resentful of affectionate contact and resist efforts to elicit play.

This general situation cannot be resolved by simply providing aggressive dogs with more affection. As already noted, giving such dogs affection may not promote affiliation but may instead generate an opposite effect: increased frustration and irritability. The critical factor is to reverse the social polarity between the owner and dog, so that the dog learns to give attention and affection to the owner, rather then receiving it exclusively from the owner. In an important sense, submissive behavior *is* affectionate behavior. Affectionate physical gestures placate the leader, rendering it more benevolent and forbearing with respect to the subordinate's intrusions. Although directing affection and attention toward a dominant individual may have an aggression-reducing or pacifying effect, directing such affection and attention toward a disaffected subordinate may exert an exactly opposite influence, perhaps, in some cases, disabling *status*-related inhibitors that restrain the subordinate from behaving aggressively toward the dominant figure. In other words, making the subordinate the *object* of affection and attention (engaging in submission behavior toward it) may inher-

ently promote annoyance, resentment, and aggressive arousal in the subordinate—an unexpected effect that may actually promote social disruption and disorganization. For example, under natural conditions, an attention- and affection-giving alpha would eventually disinhibit otherwise submissive subordinates to challenge it for social dominance. An interesting possibility is that affection giving by an alpha may be mildly aversive for it, just as receiving affection from a dominant individual may be annoying for a subordinate. Perhaps love is only possible between social equals—the alpha pair.

Reversing Social Polarity and Establishing Leadership

The etiology of dominance aggression is a complicated cluster of inherited traits (especially behavioral thresholds controlling the expression of fear and aggression) and various actualizing experiential influences, including emergent dominance relations. The usual focus on status and the importance of dominance rank and contests between an aggressor and victim-owner overshadows the vital role of social polarity (direction of affiliative interaction) in its management. As previously described, affiliative interaction between a dog and its owner is commonly conflicted in various ways. Where affiliative bonding is secure and affection mutually shared, the probability of overt aggression is much reduced. However, in situations where the dog's affection toward the owner or vice versa is compromised or conflicted by distrust or resentment (contact aversion), the likelihood of agonistic behavior is much increased. Under the influence of distrust or contact aversion, affectionate interaction between the owner and dog may become the source of considerable tension, perhaps causing the dog to become progressively annoyed, intolerant, and aggressive.

This situation can be beneficially influenced in several ways. First and foremost, in the case of a disaffected subordinate, the direction of social polarity must be reversed, so that affection and attention is directed from the dog toward the owner. As Romanes's anecdote suggests, the withdrawal of attention and affection often exercises a pronounced effect on a dog and its willingness to submit. Requiring a dog to turn its attention actively toward its owner, by withdrawing gratuitous contact and "playing hard to get," offers a viable means for initiating an about-turn in the direction of social polarity. Seeking affection is a step in the right direction toward learning to give it. The owner invites enhanced attention, affection, and other active and passive-submission behaviors by rewarding such activity with highly desirable outcomes. These changes are facilitated by initiating reward-based training activities that possess a high degree of structure, safety (predictability and controllability), and play. Such efforts are designed to promote maximum interactive success while minimizing frustration. As a result of such training activities, the dog learns *how to operate the owner* to satisfy its needs, thereby simultaneously enhancing cooperation, dependency, and submissive tendencies. Furthermore, the dog's success at controlling desirable outcomes by deferring to the owner's contingencies of reinforcement serves to inculcate the notion that cooperation pays off. Interactive success is highly rewarding for both the owner and dog, making the owner a more attractive and effective leader and the dog a more obedient and affectionate follower. Leadership is essential if the owner is to attract the dog's attention, affection, and submission.

An important goal of integrated compliance training is to secure a dog's attention and submission to owner-directed control. As this goal is gradually achieved, the dog learns to defer without resistance or resentment. However, just learning that it can control attractive events is not enough; the dog must also learn that it can control mildly aversive and intrusive ones as well. Physical control and restraint are gradually introduced under highly controlled situations of counterconditioning, response prevention, posture-facilitated subordination, and relaxing massage. Under the structure and control of such training, aggressive impulses may periodically occur, but they are usually inhibited and subside before reaching the critical threshold for attack. Graduated exposure to physical control and restraint helps to improve a dog's ability to control aggressive impulses, while

learning to rely on more constructive and cooperative means to control irritating, frustrating, or threatening situations. As a result, in addition to affectionate affiliation, a growing sense of respect and trust may develop toward the owner, in direct proportion to the owner's success in becoming an effective leader through training.

As a buffer of enhanced affection and impulse control is established, the next step in the process involves developing a playful response. As discussed previously, play provides a powerful means for mediating affiliative connectedness with dogs. Unfortunately, dominant-aggressive dogs are not always very interested in play and may resist efforts to elicit such interaction. Dogs unwilling to play may be encouraged by doing things with them that they enjoy and that may gradually be turned toward more playful interaction. Activities that simply require a dog to follow its owner's lead (e.g., a nature walk) or, perhaps, making a game of fetching or finding a hidden treat can provide a foundation for more spontaneous play as the dog learns to relax. An intensive daily exercise program can also produce striking benefits in some dominance aggressors, especially in cases in which comorbid depression is present—depression may make a dog emotionally vulnerable to increased irritability and aggression.

PLAY AND AGGRESSION

Play offers a powerful nonintrusive means to control the direction of social polarity and attention, to balance affection and leadership, and to increase feelings of affiliation and cooperation between people and dogs. Play is relatively incompatible with aggression and fear, although, under the influence of escalating frustration or threat, play may slip over into overt aggression.

What Is Play?

Among potentially aggressive social animals that establish close affiliative relations with one another, play appears to mediate and consolidate *friendships.* Playful interaction among conspecifics appears to take two general forms: some forms of play promote social affiliation and are done apparently for the joy of playing, whereas other forms of play may be used to probe the strength and character of the playful competitor. In terms of behavior, the general qualities associated with play are behavioral openness, curiosity, and flexibility. Playful activity is characterized by an ostensible purposeless purpose in which action is governed by factors independent of serious intent (Immelmann, 1980). Intraspecific play involves the exchange or expression of various species-typical behavior sequences that are emitted out of normal order and in the absence of natural triggers. Playful behavior is often exaggerated and solicitous, random and incomplete, and, in the case of aggressive components, occurs within a safe range of intensity (escalating and abating) over the course of the play episode. In addition, play often involves explicit and inappropriate sexual behavior (e.g., male dogs mounting other males). A large percentage of a dog's play behavior involves competitive components incorporating low-intensity threats and aggressive displays kept within noninjurious limits. Actually, competitive play is structurally comparable to actions, which, if emitted under the influence of aggressive establishing operations and contexts, could result in severe injury or even death to the players. For dogs, play is an essential element in the development of healthy social attitudes and essential interactive repertoires with other dogs and people (Fagen, 1981).

Metacommunication and Play

Play depends on the exchange of various auditory, facial, and bodily expressions (e.g., play bow and play face) defining an intent to play. These play invitations are highly ritualized patterns of mutual identification, feigned diminutiveness, and neotenic care-seeking and active-submission behaviors. Bateson (1976) characterizes these various preliminary messages as a form of metacommunication, that is, expressive signals forming a communicative context by which the participants can properly interpret the behavioral events that follow. During an invitation to play, these vari-

ous messages are communicated to reassure the other (and perhaps the sender) that the activity is, in fact, just play. According to Bateson, these various signals state, "These actions in which we now engage do not denote what those actions for which they stand would denote [otherwise]. . . . The playful nip denotes the bite, but it does not denote what would be denoted by the bite" (121). In other words, the preliminary signals communicate about the forthcoming events in terms that reach *beyond* the obvious denotations. He argues that the mammalian evolution of play signals may represent an important evolutionary step in the development of communication. Buytendijk (1936) argues that a dog's ability to communicate symbolically through gesture, body language, and vocalization has played a vital role in its successful domestic adaptation:

> Taking one thing with another, there is indeed no other animal in our environment that has so many means at its disposal for rendering the intensity of its actions symbolic. This explains (1) why man has ascribed to the dog as intense a faculty of feeling as he himself possesses; (2) why man believes he understands the dog; (3) why the dog is so exceptionally capable of accompanying man, and of being spoken to and treated as a house-mate, a friend, and brother. (65)

A common example of metacommunication related to play is the play smile or canine grin. Many dogs exhibit a "smile" during greetings and other times of excitement. The grin is superficially similar to the baring of teeth exhibited during agonistic displays. Both the grin and the snarl are formed by retracting the upper lip back and exposing the incisors and canines. Although a grin is sometimes confused with a snarl, many facial and bodily indicators confirm a nonaggressive and prosocial intention. Instead of communicating a threat, the play smile clearly invites playful social interaction. Darwin (1872/1965) long ago gave a very plausible account for the development of this canine social custom:

> Some persons speak of the grin as a smile, but if it had been really a smile, we should see a similar, though more pronounced, movement of the lips and ears, when dogs utter their bark of joy; but this is not the case, although a bark of joy often follows a grin. On the other hand, dogs, when playing with their comrades or masters, almost always pretend to bite each other; and they retract, though not energetically, their lips and ears. Hence I suspect that there is a tendency in some dogs, whenever they feel lively pleasure combined with affection, to act through habit and association on the same muscles, as in playfully biting each other, or their masters' hands. (120)

In another insightful passage, he keenly describes another common example of metacommunication at work:

> When my terrier bites my hand in play, often snarling at the same time, if he bites too hard and I say *gently, gently,* he goes on biting, but answers me by a few wags of the tail, which seems to say "Never mind, it is all fun." (120)

It should be noted that the canine grin may function in a variety of ways, some of which may be ambiguous and not indicative of an intention to play. Some dogs under the influence of conflicted or nervous intentions may grin in an effort to cut off interaction. Cutoff signals appear to be offered as gestures of compromise in situations involving social conflict (see *Cutoff Signals* in Volume 1, Chapter 10). The cutoff or compromise signal is not a submissive gesture but an opportunity for the contestants to call a draw and disengage without loss or gain. Generally, the cutoff signal appears to have a mutually pacifying effect that curtails tensions before they escalate into more serious conflict. Cutoff signals are often presented during playful activity, especially when things get too competitive or threatening for one of the players.

A common form of metacommunication exchanged by playing dogs is the play bow. Bekoff (1977) studied the function of play signals in both domestic and wild canids and observed that the play bow serves two primary functions: (1) the signal communicates an animal's intention to play in the first place, and (2) the signal confirms the continuance of a playful mood, thus preventing play from escalating into more serious fighting. Bekoff observed that play bows occur more frequently after certain agonistic actions (e.g., biting and

side-to-side head shaking) that might be misinterpreted by a playful opponent as a threat (Bekoff, 1995). He argues that play bows under such circumstances may serve to disambiguate the meaning and playful intention of such behavior:

> In addition to sending the message "I want to play" when they are performed at the beginning of play, bows performed in a different context, namely during social play, might also carry the message "I want to play despite what I am going to do or just did—I still want to play" when there might be a problem in the sharing of this information between the interacting animals. (426)

In the case of play between adult dogs and puppies, the former might lie down on its side or back and engage the latter in jaw wrestling and gentle pawing. Figuratively speaking, each player must temporarily discard its social armor and weapons in order to play. Play may evoke a shared sense of relief from the various accustomed expectations and roles ordinarily required from each of the participants. Between familiar dogs, dominant-subordinate roles change fluidly during play, but such transitions may be more stiff and tenuous in the case of unfamiliar dogs playing for the first time. In such cases, there is a significant risk that play may inadvertently escalate into overt fighting. Play may also turn aggressive when one of the participants abruptly decides to quit before the other is ready. Usually, however, play is peaceful and socially constructive, functioning to promote harmonious interaction and mutual tolerance between play partners.

Social Learning and Play

The ability to play is contingent on a balance of health and emotional stability. Overly aggressive, fearful, depressed, or sick dogs do not show significant interest in play. Play exudes a sense of security and well-being together with an open willingness to accept come-what-may during the course of playful interaction and exploration. Play encourages an empathic sensitivity involving gentleness and tolerance while expressing oneself in aggressive and sexual forms. Eibl-Eibesfeldt (1971) reports that animals that fight among themselves as adults practice agonistic skills as young, learning appropriate restraints and bite inhibition. If one partner in play bites too hard, the "injured" play partner yelps, quits playing, and may retaliate in earnest, thus teaching the aggressor better bite inhibition in the future. It is very likely that play is the means by which dogs learn appropriate restraint and inhibition over aggressive and other socially disruptive behavior patterns (Bekoff, 1972). In many respects, play is a socially unifying activity that stands in direct opposition to the socially dispersing influence of agonistic behavior. Bekoff (1974) concluded from a comparative study of coyotes, dogs, and wolves that "canids which play together tend to stay together" (227). He found that the relative amount of play exhibited versus agonistic behavior in early life is a reliable indicator of the degree of sociability exhibited by the animal as an adult. Play appears to serve an important role in the facilitation of long-term affiliative behavior among wolves and dogs—a tendency that is notably lacking in the more socially aggressive and *lonely* coyote.

Among wolf pups, aggressive behavior and biting peak between weeks 8 and 12. During play, participants learn "the fact that hard biting results in *aggressive reaction* (italics added) by the wolf who has been bitten" (Zimen, 1981:186). As the result of aggressive retaliation and submission, play becomes more friendly and social interaction progressively more orderly and peaceful as bite inhibition develops and the puppy learns to benefit from social signals. In combination, social dominance and competitive success over the control of food and other resources facilitate the emergence of more or less stable dominance relations between competing littermates. As a result of such competition, a ranking order is established to promote more peaceful and cooperative interaction and the prevention of disruptive fighting. As the result of playful sparring and aggressive competition, the puppy appears to internalize a lasting impression of its relative status (that is, its general ability to control others in a competitive context). Although highly aggressive puppies may secure and maintain dominance from an early age, the

process of social definition is usually labile, with dominance relations becoming progressively stable between littermates between weeks 11 and 17 (Scott and Fuller, 1965).

Play facilitates social learning between dogs and between people and dogs. The presence of interactive tolerance and the exchange of affection during bouts of play provide an atmosphere of flexibility under which puppies and dogs can readily learn self-control and interactive restraint. This readiness coupled with a playful puppy's ability to switch back and forth quickly from behaviors belonging to unrelated functional systems gives play the ability to facilitate the formation of unique or new linkages, flexibility that is extremely useful for behavioral training efforts and the modification of various behavior problems. Play and exploratory curiosity are essential to learning both about the environment and about others—canine and otherwise:

> The animal collects experiences during play with conspecifics and learns the possible range of its own movements. Play always implies a dialogue with the environment, and this dialogue is always the result of an internal drive. One could even assume a separate drive for play, but I am inclined to believe that the drive to learn, which is the basis of all curiosity behavior coupled with an excess of motoric motivation, will suffice to account for the phenomenon of play. (Eibl-Eibesfeldt, 1970:240)

An important use of playful interaction among animals is the testing and probing of social relations, including social status. Pellis and Pellis (1996) note that the dominance-testing function of play is especially relevant in the case of postpubertal animals:

> We suggest that the primary function of postpubertal play fighting is that of social manipulation, either to recruit or maintain "friendships," or to improve one's status in the group. For the latter purpose, one animal has to test and probe its relationship with another. If such probing reveals weakness, the performer can increase the intensity or roughness of play or even switch to more explicitly agonistic behavior. In this way, the performer may intimidate the opponent, thus gaining access to current or future resources. But what if such rough play meets with strong resistance? The problem is then to back down, or de-escalate the encounter. An amicable signal that conveys the message "it was only play" would be invaluable. (260)

During playful interaction, aggressive behaviors are emitted at very low intensities and dogs are much more tolerant of provocative handling. Further, since dominant-subordinate roles are more fluid during play, a dominant dog or puppy can be more easily encouraged to adopt a subordinate role and learn the benefits of cooperation and submission by making various rewards available at such times. In an important sense, effective behavioral training is play with a structure and purpose. Structured play interaction provides an excellent tool for the modification of many emotionally debilitating problems besides dominance aggression. Play is commonly combined with other behavior-modification procedures in the management and control of fearful behavior, social excesses, and a variety of impulse-control problems.

Note: Initiating play with a dominant-aggressive dog with a history of serious attacks is potentially very dangerous. Such activities are only slowly and carefully introduced after significant behavior modification has taken place to reduce the risk. Dominant-aggressive dogs often exhibit a striking lack of interest in play and may resent playful initiatives and respond aggressively if prompted to play.

Cognition and Aggression

Among highly evolved animals like dogs, executive cortical systems exercise significant regulatory control over the expression of emotional behavior. These cognitive appraisal and regulatory processes serve to excite or inhibit relevant motivational substrates selectively. Cognitive influences finely tune the dog's emotional state and prepare it for action according to the needs defined by the moment-to-moment circumstances confronting it, thus giving behavior a high degree of expressive accuracy and subtlety. Cortical and subcortical interactions are analogous to the relationship between a conductor and an orchestra. Although the orchestra is composed of many disparate musical instruments and sounds, it is given harmonious organization and direction under the executive command

of the conductor's baton, thereby producing music instead of cacophony.

Unfortunately, executive cognitive control efforts often fail to regulate highly motivated behavior such as fear and rage. The afferent and efferent interconnections between the cortex and the subcortical areas responsible for the elaboration of fear, anger, and rage are asymmetrical, with stronger input going into the cortex than leaves it to modulate the activity of these influential areas of the brain (see *Cerebral Cortex* in Volume 1, Chapter 3). In other words, one cannot just command "Don't be afraid" or "Don't be angry" and expect the subcortical areas involved to be quieted. Executive control is not exerted like an on-off switch that activates or deactivates the selected arousal system; instead, such influences are mediated through the cortical activation of opposing motivational systems: *contraries cure contraries.* For example, an angry impulse may be offset by an opposing fearful impulse that is evoked by a *recognition* that aggression will probably not succeed and may actually fail and possibly cause the perpetrator harm. In this case, fear appears to restrain anger, whereas, in other cases, anger may reduce fear.

The central arousal of fear competes with anger and elevates behavioral thresholds for aggressive behavior, but only if such stimulation occurs before an attack is launched. Once an attack is under way, threats and efforts to physically punish aggressive behavior typically worsen the situation. Under the potentiating influence of rage, aggressive efforts become progressively immune to the restraining effects of fear. To inhibit aggression, fear must reach a sufficient threshold to generate an inhibitory response before a dog commits to an aggressive action. Once aggression occurs and rage is elicited, it is too late to attempt to restrain the behavior with fear-eliciting tactics. Finally, it appears that emotional impulses are hierarchically organized, with some being prepotent and inhibitory over the expression of less potent subordinate impulses (Izard, 1993). Although fear and anger tend to exert reciprocal inhibitory effects on each other, the relationship between rage and fear is not reciprocal: rage restrains fear, but fear does not appear to restrain rage.

ANXIETY, FRUSTRATION, AND AGGRESSION

Aggression (threat or attack) is driven by aversive affective states, prompted by natural or learned triggers, and guided by cognitive appraisal. Clearly, an increased likelihood of aggression occurs under conditions of heightened anxious or frustrative arousal (Figure 8.3). Both anxiety and frustration, occurring as the result of loss or threat, may trigger preparatory arousal (vigilance and behavioral invigoration) and lower aggression thresholds (Figure 8.4). Just as anxious arousal appears to reflect a mild stimulation of the fear system, frustrative

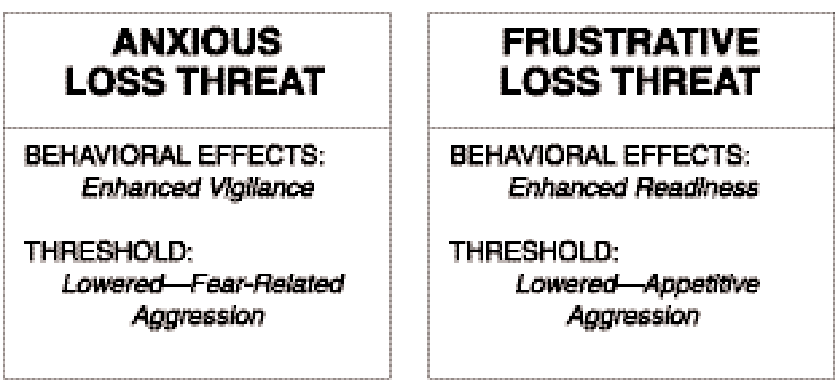

FIG. 8.3. Control-related aggression thresholds are lowered by the presence of anxiety (enhanced vigilance) and frustration (enhanced readiness).

arousal may reflect mild activation of the aggression-rage system (Panksepp, 1998). In addition to the threshold-modulating influences of anxiety and frustration, a dog's disposition to behave aggressively depends on a past history of agonistic successes and failures. For example, under conditions of forceful restraint, both anxiety and frustration may be evoked, triggering autonomic arousal and behavioral invigoration that may result in aggressive efforts to escape. If the aggressive effort is successful, both anxious and frustrative arousal are immediately reduced and replaced by opponent relief and elation, potentially providing significant reinforcement for the behavior. Under similar circumstances in the future, stimuli associated with the situation may elicit preparatory anxious arousal in advance of impending restraint, thereby causing the dog to threaten or attack even before it is touched; that is, the dog may learn to respond preemptively to situations portending loss or threat. The decision to threaten or attack appears to be regulated by a cost-benefit assessment of the situation. Aggression is most likely to occur under circumstances in which the likelihood of success is high and the potential costs are low if aggression fails. Conversely, aggression is least likely to occur under circumstances in which the likelihood of success is low, and where a significant cost is at risk if aggression fails. Aggressive behavior is most likely to conform to a cost-benefit analysis under social circumstances that are both highly predictable and controllable. However, under the influence of uncontrollable and unpredictable circumstances involving high levels of anxiety and frustration, aggression may occur in a much more erratic and impulsive way (Figure 8.5).

To a significant extent, the behavioral treatment of aggression problems involves altering behavioral thresholds by appropriately modifying anxiety and frustration levels. Conditioned anxiety is addressed by means of various classical conditioning procedures, whereas conditioned frustration is modified by instrumental training efforts that give dogs constructive alternatives with which to control or cope with frustrating or threatening situations. In combination, these various behavior-modification procedures help to systematically disconfirm anxious-frustrative expectancies mediating aggressive behavior by fostering incompatible expectancies based on security and confidence, that is, heightened trust. Systematic training activities provide dogs with a highly predictable and controllable framework for experiencing and coping with motivational adversity.

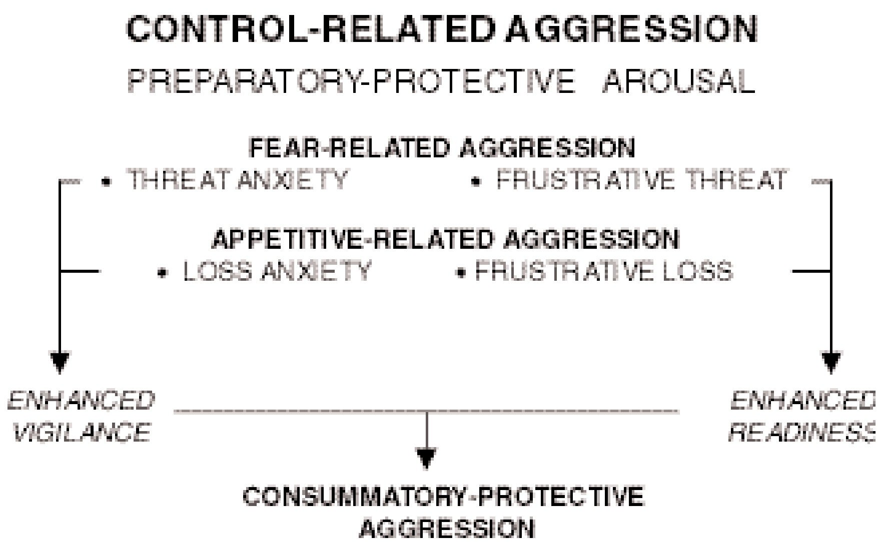

FIG. 8.4. Anxiety and frustration serve to prepare dogs for aggression by enhancing vigilance and motivational readiness.

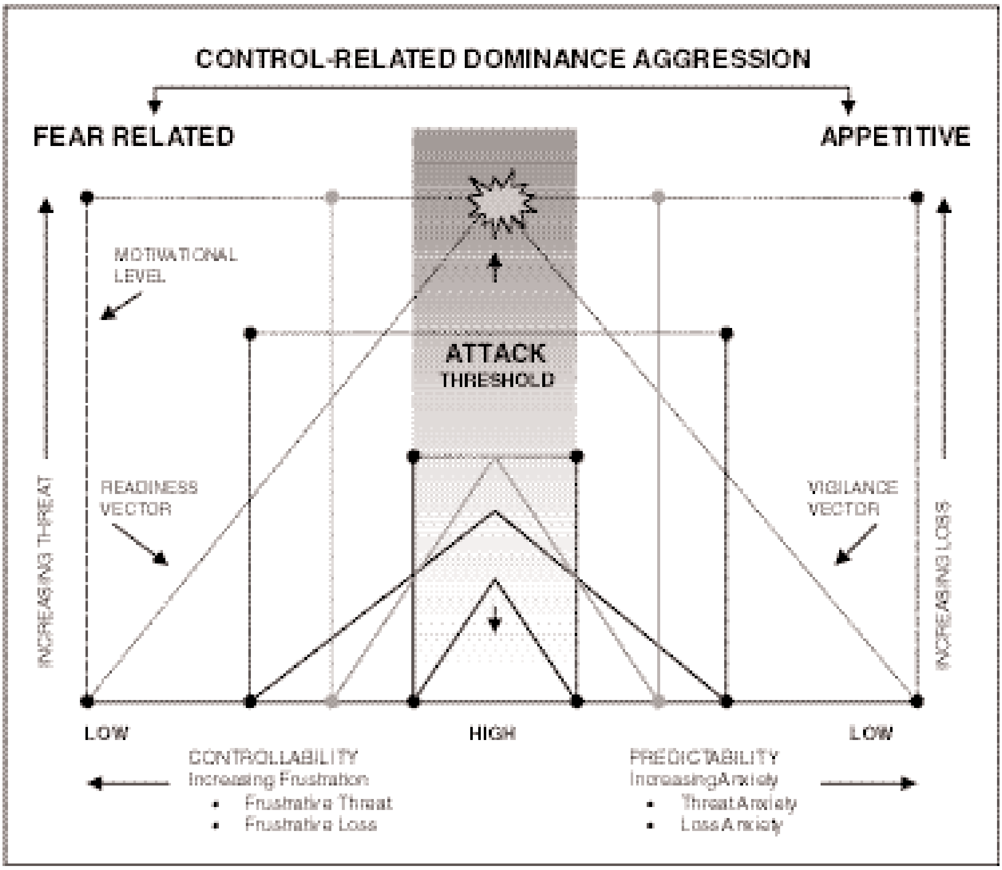

FIG. 8.5. Various contributory cognitive and motivational factors interact to influence the attack threshold. The perceived controllability and predictability of the situation exercise a pronounced influence. Under enhanced motivational conditions of impending threat or loss, vigilance and readiness vectors angle steeply in relation to the degree of control or predictability present, with an attack most likely under conditions where the event is both unpredictable and uncontrollable. Note that the likelihood of attack is correspondingly reduced as the size of the threat or loss is reduced and the event's controllability/predictability is increased.

BEHAVIORAL THRESHOLDS AND AGGRESSION

The vast majority of dogs go through life without ever exhibiting dominance-related aggression problems. Many dogs are exposed to similar rearing and training practices, but relatively few of them develop serious aggression problems. Presumably, permissive and unassertive owners would be more likely to foster dogs exhibiting dominance-related problems. Although some putative differences between owners of aggressors and nonaggressors have been suggested from time to time, nothing robust or explanatory has been identified. In fact, most studies to date have found little or no correlation between owner personality traits, anthropomorphic attitudes, or spoiling activities and the incidence of dominance-related aggression problems (Dodman, 1996; Goodloe and Borchelt, 1998; Voith et al., 1992) The relative independence of aggressive behavior and owner rearing or training practices reduces the likelihood that dominance-related aggression problems are caused primarily by status conflicts.

The control theory of aggression escapes similar criticism by emphasizing motivational considerations, such as anger, frustration, and

irritability. These aggression-promoting establishing operations are offset or modulated by incompatible or affiliative establishing operations, such as affection and trust. The essential difference between control- and status-related dominance aggression is that control-related aggression is emitted in order to dominate some situation without reference to the relative status of aggressor and victim, whereas status-related aggression is emitted under circumstances in which a subordinate (past loser) fails to recognize and appropriately defer to an opponent's dominant status. Although status may be a significant factor in some cases of interspecific dominance aggression, unless the *status* concept is carefully delimited in functional terms, it may only confuse matters and impede training efforts. The status of social competitors is an emergent attribute defined by their relative successes or failures resulting from past conflicts and contests: winners are dominate and losers are subordinate. A potentially useful way to understand status in functional terms is provided by the control-vector analysis discussed in Chapter 7. In essence, status signals power and a history of aggressive success.

Many biological factors disposing dogs toward competitive success are inherited, for example, its size and physical health. In addition, various behavioral thresholds conducive to combative success appear to be inherited. Price (1998) argues that the primary effect of domestication on behavior has been to alter behavioral thresholds. Of particular interest is the alteration of behavioral thresholds controlling the freeze (mild fear), flight (strong fear), and fight reactions. Obviously, not all dogs show the same response to aversive stimulation; these differences of behavior are primarily due to emotional and behavioral thresholds. For example, some dogs exhibit a very low fear threshold and may freeze or flee in response to minimal fearful stimulation [e.g., fearful pointers (see *Nervous Pointer Dogs* in Volume 1, Chapter 5)], whereas other dogs may exhibit a very high fear threshold and exhibit extraordinary tolerance for such stimulation (Krushinskii, 1960). On the other hand, some dogs exhibit a low aggression threshold to provocative stimulation and are quick to *fight* in response to minimal annoyance, whereas other dogs, possessing a high aggression threshold, may become aggressive only under the most extreme and provocative stimulation. Combining these opposing behavioral thresholds results in four sets of characteristics, latencies, and predictions (Figure 8.6). During competitive contests, dogs combining a low aggression threshold and a high fear threshold (quadrant 2) enjoy an advantage over opponents exhibiting a high aggression threshold and a low fear threshold (quadrant 3). For example, a dog that attacks with minimal provocation is likely to dominate a more inhibited counterpart who submits or runs away when minimally threatened (Pawlowski and Scott, 1956). Also, the tendency of male puppies to dominate female puppies may be due to the threshold-lowering effects of perinatal androgenization on neural substrates mediating the expression of aggressive behavior. Although these various thresholds are significantly influenced by biological factors, they are also subject to the actualizing influence of experience and learning (Krushinskii, 1960). Typically, dogs exhibiting control-related dominance aggression problems fall into quadrants 1 and 2. An important aspect of treating such problems involves systematically altering behavioral thresholds in the direction of quadrant 4. In the case of dogs exhibiting characteristics belonging to quadrant 1, behavior-modification efforts should aim at simultaneously elevating aggression and fear thresholds, whereas, in the case of dogs showing characteristics belonging to quadrant 2, training efforts should be primarily focused on elevating the aggression threshold. Note that attempting to increase control by lowering fear thresholds (flight) in dogs belonging to quadrant 2 may inadvertently push them in the direction of quadrant 1, with an increased risk of aggression and rage—an unfortunate and common iatrogenic outcome of training in cases in which overt aggression is physically punished.

This general scheme nicely explains how a dog possessing a high aggression threshold and a low fear threshold (quadrant 3) might be induced to attack. Under circumstances in which such dogs are strongly aroused with fear but prevented from escaping, the fight threshold may be finally reached, causing the

	LOW-FLIGHT	HIGH-FLIGHT
LOW-FIGHT	1 LOW-FIGHT/LOW-FLIGHT *LATENCY:* Quick to aggression- Quick to fear *PREDICTION:* High probability to exhibit aggression with significant rage potential	2 LOW-FIGHT/HIGH-FLIGHT *LATENCY:* Quick to aggression- Slow to fear *PREDICTION:* High probability to exhibit control-related dominance aggression
HIGH-FIGHT	3 HIGH-FIGHT/LOW-FLIGHT *LATENCY:* Slow to aggression- Quick to fear *PREDICTION:* High probability to flee--low probability of aggression, unless flight is blocked	4 HIGH-FIGHT/HIGH-FLIGHT *LATENCY:* Slow to aggression- Slow to fear *PREDICTION:* Low probability for aggression or fleeing, except under the most extreme duress or threat

FIG. 8.6. Matrix of behavioral thresholds controlling flight (fear) and fight (aggression).

dogs to attack the source of stimulation. If the attack is successful, such dogs may form a highly undesirable inference about how to control fearful stimulation or threats in the future, thereby lowering the controlling threshold for aggression. When threatened in future, a quadrant-3 dog may threaten or attack preemptively instead of waiting and possibly being hurt again. This *learned trigger* overrides or bypasses low-threshold fear inhibitions (freeze or flee) and directs the dog to attack. In this case, the dog attacks—not because of fear but in spite of fear. Under such influences, aggressive behavior may be liberated from modulatory threshold influences and natural triggers, gradually being elicited by a variety of stimuli and in minimally provocative and inappropriate contexts.

Under the assault of aversive stimulation, escape appears to be prepotent over attack, but attack is easily learned as an escape/avoidance response if it serves to terminate aversive stimulation (Azrin et al., 1967). The inhibitory effects of fear are especially compromised in situations where aggression has proven more successful than submitting or running away in the past. This particular form of aggression is especially responsive to behavior modification, since the *learned trigger* can be counterconditioned, causing the aggression threshold to gravitate gradually back to its *natural* level. In addition, such dogs are often very inhibited aggressors that seem to want to find a way out of conflict situations without resorting to aggression.

Theoretically, puppies exhibiting quadrant-1 traits would be at a higher risk of developing aggression problems as adults, regardless of owner rearing and training practices. When exposed to aversive stimulation, such puppies may respond to the punishing agent (e.g., the owner) with both fear and anger—a highly undesirable state of affairs. As a result of such motivational collision, fear may become progressively linked with anger and aggression. Instead of inhibiting attack (submission) or causing such puppies to submit, the elicitation of fear may stimulate aggression through its linkage with anger and rage circuits. Punishment in such cases may only stimulate more anger and aggression. The result is a spiraling escalation of rage, continuing until aversive stimulation is stopped. Conceivably, if such motivational cross-linkages are formed early enough in a dog's development, especially before fear and anger/rage neural circuits are fully differentiated and segregated, a very serious and explosive form of aggression might be incubated and finally expressed in adulthood (Panksepp, 1998).

Aversive Trauma, Social Loss, and Aggression

Although abusive treatment should be avoided in the rearing of dogs, punishment per se (even when highly aversive and noncontingent) may not always result in a predisposition for aggression or fearfulness in puppies with sufficiently high behavioral thresholds for aggression and fear. Although a history of abuse and trauma may represent a necessary cause, these experiences alone are not sufficient for the development of adult social behavior problems involving excessive fear or aggression. In fact, as shown by Fisher (1955), many puppies appear to be surprisingly resilient to the effects of traumatic treatment (see *Early Trauma and the Development of Behavior Problems* in Chapter 4). Fisher's findings draw into question the role of adverse and traumatic conditions in the development of maladaptive behavior in dogs. The modulating effects of behavioral thresholds provide a key to understanding why some dogs can undergo detrimental experiences but not exhibit lasting signs of disturbance, whereas others appear to be profoundly and permanently debilitated by such experiences. Pavlov (1927/1960) was the first to recognize that certain temperament types are more susceptible to the elaboration of neurotic disturbances; especially vulnerable are those dogs prone to excessive excitation (choleric) or inhibition (melancholic) (see *Experimental Neurosis* in Volume 1, Chapter 9). Detrimental environmental conditions are most likely to exert lasting disturbances in dogs possessing excessively low thresholds to aversive stimulation. According to this analysis, a genetic predisposition affords conditions under which exposure to traumatic events may provide the conditions (distal setting events) under which influence adversity (proximal establishing operations) may result in persistent aggressive or fearful behavioral disturbances. Normally, aggression is physiologically and psychologically self-limiting and used only under adverse motivational conditions (e.g., frustration, irritability, and threat). Aggression occurring outside of this basic pattern is often the result of neurotic elaborations or an underlying physiological pathology.

Depending on individual temperament variations, stressful separation and loss may exert a pronounced effect on a dog's behavior by increasing social avoidance and aggression—changes that may persist even after contact with the attachment object is restored. E. C. Senay (1966) studied behavioral changes occurring in dogs following an abrupt cessation of social contact (abandonment) and subsequent reunion after 2 months of separation. Beginning at week 3 and continuing until 9½ months of age, the researcher established close contact with six German shepherd littermates. The behavior of the puppies was carefully monitored and evaluated prior to separation, after separation, and after reunion. During the 2-month period of separation (from 9½ to 11½ months), a noninteractive caretaker cleaned their pens and fed them.

From the onset and over the course of the study, the puppies exhibited consistent behavioral tendencies in terms of social affiliation and approach scores versus avoidance and aggression scores. Three of the puppies were highly cooperative and socially attracted to

the experimenter and actively sought to maintain close contact with him (*approach temperament*), whereas the other three exhibited varying degrees of avoidance and aggression (*avoidance temperament*). Puppies exhibiting affiliative-approach tendencies received the highest scores with respect to responsiveness to discipline and trainability. These puppies showed a minimum amount of social avoidance when disciplined and a high degree of responsiveness to training. In contrast, socially avoidant and aggressive puppies received the lowest discipline and trainability scores, exhibiting a high degree of avoidance and resistance to training efforts.

Puppies exhibiting the highest preseparation approach scores showed increased social interest and attraction toward rater-observers entering the holding pen during the period. On the other hand, puppies exhibiting high avoidance and aggression scores prior to separation became even more avoidant and aggressive during the 2-month separation period. Interestingly, puppies with *avoidance temperaments* showed a significant decrease of activity during the separation period. Upon reunion with the experimenter, the trends toward increased attraction and affiliation, on the one hand, and increased avoidance and aggression, on the other, continued to increase during the first 2 weeks after reunion, before returning to preseparation levels after another 2 weeks of restored contact with the experimenter.

Senay observed a strong correlation between arousal levels and temperament type. Avoidant-aggressive puppies tended to exhibit a high level of general arousal and excitability, with tachycardia and excitable urination being exhibited by the most avoidant and aggressive puppies in the group, whereas puppies exhibiting less excitability and reduced arousal levels showed more approach behavior and *no* aggression:

> Early in life the animals seemed to possess differences in their neurophysiologic arousal systems. These differences seemed to determine whether object presentation [presence of the experimenter] would have organizing (approach temperament) or disorganizing (avoidance temperament) effects on the behavioral patterns of the animals. . .. The observations made here suggest that with stimulation from the object held constant, animals possess individual differences in their arousal mechanisms and furthermore, that these differences are crucially involved in separation phenomenon. (70–71)

These findings underscore the importance of affectionate affiliation for the control and prevention of aggression problems, and emphasize the role of behavioral thresholds in their etiology and development. Separation from an attachment object may produce significant stress and alter avoidance and aggression thresholds in predisposed dogs possessing an *avoidance temperament,* while enhancing affiliative bonding and cooperation in dogs influenced by an *approach temperament.* Interpreted from a behavioral perspective, separation represents a setting event (distal influence) that motivationally alters a puppy's later responsiveness to establishing operations (proximal influence) associated with avoidance and aggression. Early traumatic experiences can be interpreted in similar ways. Predisposed puppies exposed to an excessively frightening experience (setting event) may be more responsive to similar conditioned and unconditioned experiences (establishing operations) occurring later in life. The early traumatic setting event may consequently cause such dogs to acquire related avoidance or aggressive behavior more rapidly and efficiently.

LEARNING AND DOMINANCE

As has already been repeatedly emphasized, dominance is synonymous with control. Dominance contests occur when a dog is prompted to do something it would prefer not to do, constrained to forego some preferred activity, or required to relinquish some possession it would prefer to keep. Consider, for example, a competitive contest by two dogs over a location or resource (Figure 8.7). During the contest, the more dominant of the two opponents will *prompt* the subordinate with a direct threat (e.g., stiff posture, stare, and snarl) to withdraw from the situation. If the subordinate fails to defer, the dominant animal may escalate its threats, or attack if its threats continue to be ignored. Assuming that the dominant dog's efforts are

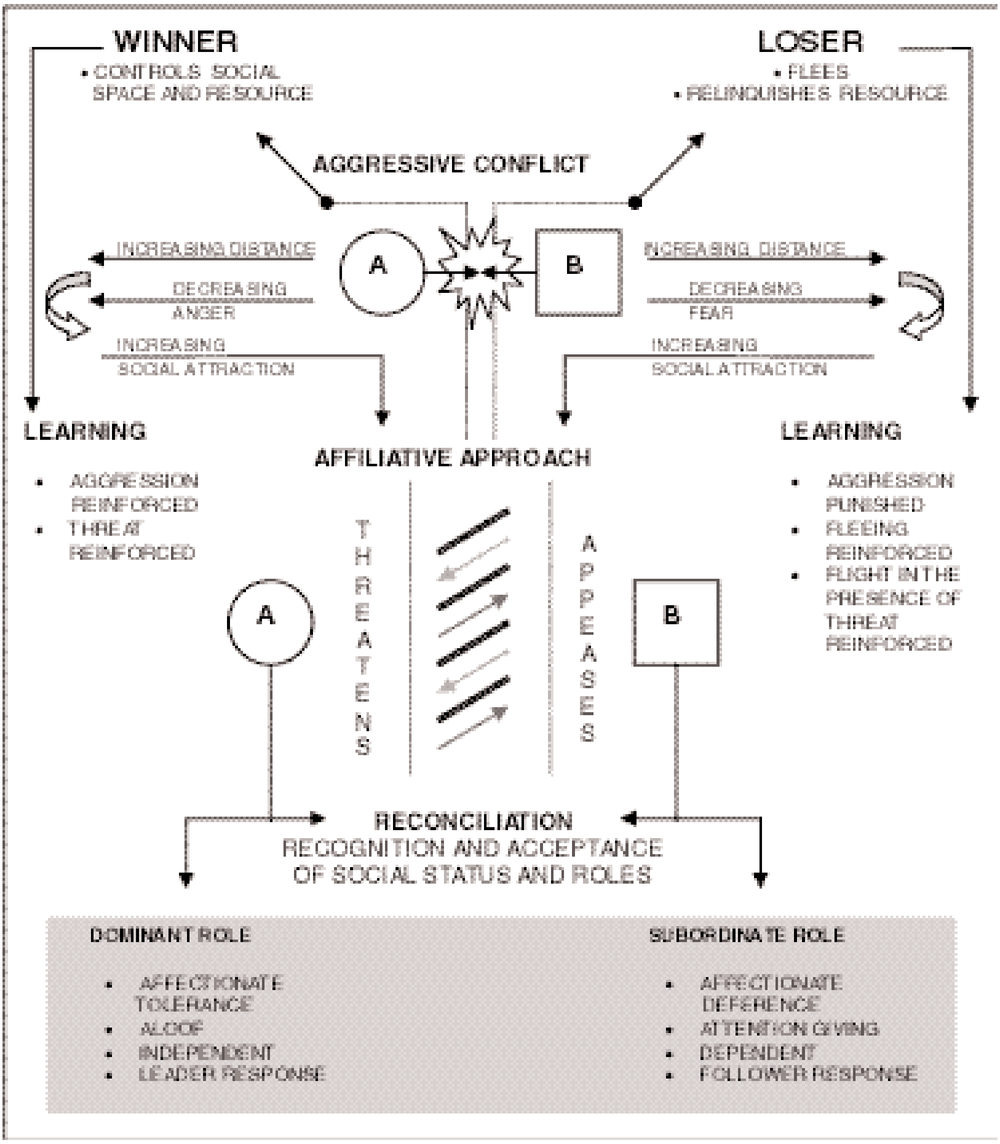

FIG. 8.7. Various outcomes resulting from agonistic interaction. Immediately following an aggressive encounter, anger and fear enhance social distance between combatants. Over time, anger and fear wane and are replaced by increasing levels of social attraction and affiliative interest. As contact is restored, threat and appeasement displays facilitate reconciliation, with opponents recognizing each other's social status and respective roles. Note the various effects that learning has on aggressive interaction.

successful, both the assertive behavior of the winner and the flight/submission of the loser are reinforced, but the reinforcement experienced by the two contestants is based on opposite reinforcing effects. The dominant dog's assertive behavior is positively reinforced twofold, since it successfully displaced the rival, as well as served to secure the resource (e.g., a bone). The subordinate's behavior is both punished and negatively

reinforced. On the one hand, the subordinate's competitive adventure failed to control the resource (punishment), whereas, on the other, it succeeded in escaping the dominant dog's attack. As a result, during future competitive interaction between the two dogs, the dominant animal will be more likely to successfully assert rank, whereas the subordinate will be more likely to submit or flee. In addition, the subordinate will likely learn to avoid future contests with the winner. By exhibiting submissive behavior toward the threatening rival, the subordinate avoids attack and its submissive behavior is reinforced. Likewise, the subordinate's deferential response to threat or attack reinforces such displays in the dominant dog. In the future, contests between the two rivals are resolved largely through the exchange of ritualized threat and appeasement behaviors—displays that are highly *prepared* (species typical) and quickly learned.

Threat and appeasement displays may be conceptualized as triggers producing opposite establishing operations in the competitors. In the case of dominant animals, appeasement signals evoke motivational changes conducive to reducing aggressive behavior (reduces anger), whereas, in the case of subordinates, threats evoke motivation changes conducive to the emission of submissive behavior and withdrawal (increases fear). In both cases, under the influence of relevant establishing operations and motivational states, corresponding dominant-role and submissive-role *playing* is reinforced.

Following an assertion of dominance, the subordinate may run to a safe distance from the dominant alpha, but, as time wears on, affiliative pressures for social contact will cause it to gravitate back into closer proximity with the alpha. With contact restored, its social separation distress is reduced, thereby reinforcing affiliative behavior and increasing affection for the *magnanimous* alpha. Although the alpha may experience feelings of social loss as well, its distress may be felt much less keenly, since it is compensated with the elation and spoils of victory. Further, the alpha may view the social distance set between itself and its rival as part of its overall success. Dominant dogs possess a certain comfort with social distance, not appearing to need the reassuring social contact sought by submissive subordinates or at least not needing it in the same way or degree. Dominant dogs are more likely to receive affection rather than to give it out.

The direction of affectionate exchange supports the development of dominance-enhancing social polarity between the competitors, making the subordinate less likely to attack the alpha and making the alpha more tolerant of the subordinate's presence. Social polarity is a strong inhibitory and stabilizing influence on the dominant-subordinate relationship. Along similar lines, the alpha is more likely to emit distance-increasing (dispersal) behavior, whereas the subordinate is more inclined to emit distance-reducing (attraction) behavior. If the subordinate is to remain in close contact, however, it must accept a submissive role relative to the alpha's dominant status and prerogatives. Submission-enhancing interaction occurs among all group members until a hierarchy (not necessarily linear) of dominant-subordinate relations and dominance-supporting allegiances is formed.

Following a successful contest, future competitive interaction between the victor and the loser will probably take the form of threat and appeasement displays, indicating the importance of avoidance learning to the process of establishing social dominance. The threat or mere glance alone is now sufficient to evoke submission without needing to resort to an attack, although an occasional aggressive assertion of control may still occur from time to time. This appears to be a desirable arrangement for both the alpha and the subordinate. A possible factor restraining the alpha's use of overt aggression is that such behavior may be intrinsically aversive for it to perform—reminiscent of the reluctance of many owners to punish unruly dogs. Aggression may be *reinforced* insofar as it secures control but is probably not *reinforcing* for its own sake, at least not under normal circumstances. In fact, brain studies involving microstimulation of limbic system areas dedicated to the expression of aggression have

shown that affective aggression is physiologically aversive for the stimulated animal (Adams and Flynn, 1966). Consequently, the alpha is not likely to attack subordinates casually or as a way to obtain *pleasure* at the subordinate's expense. For the subordinate, aggression is doubly aversive, because its own aggressive efforts are both intrinsically aversive and unsuccessful; that is, they result in punishment. Finally, there is always some risk of injury to the alpha as the result of fighting, so avoiding unnecessary combative contests would make sense on the level of self-preservation and safety, as well. Ultimately, the exchange of threat and appeasement display establishes a foundation for social organization and purposeful coordinated activity.

Submission behaviors appear to consist of exaggerated species-typical canine infant behaviors. Among many mammalian species, a strong inhibition prevents adults from attacking their young. Submission displays appear to take advantage of these innate inhibitions and taboos. Such displays are highly prepared responses learned without much experience and triggered by an alpha's threats. In turn, these submissive or appeasement gestures and postures trigger inhibitory control over the alpha's aggressive threats, preventing them from escalating into a full-fledged attack. In the presence of the alpha leader, the subordinate appears to act somewhat like an obsequious infant. These caricature infantlike behaviors appear to evoke paternal (or maternal) caregiving and protective responses toward the subordinate.

Although the subordinate may initially flee and stay away from the dominant victor, in time a growing need for social contact asserts itself. Submissive behavior emerges under the combined influence of fear and social attraction. In an important sense, social attraction overshadows fear and restrains the impulse to flee too far or stay away too long. Much like a rubber band stretched between the alpha and the subordinate, social attraction grows as a motivational tension in proportion to the distance and time spent fleeing. Gradually, needs for social contact attract the subordinate back into closer proximity with the alpha. The subordinate's approach takes place against a building fear gradient but is facilitated under the counterconditioning influence of *affection.* The combination of fear and affection evokes the expression of submissive behavior. In short, *submission* is a motivational composite of *fear and affection.*

Gradually, the subordinate may learn that submissive displays *work* and can be used to manipulate the alpha. This *knowledge is power,* and the clever subordinate may even mock or tease the alpha, thereby narrowing the social distance and disturbing social stability between the two potential rivals. In addition, social polarity is shifted by the amount of attention and effort that the alpha must divert in the direction of the enterprising subordinate. The subordinate may also learn that the alpha does not really like being aggressive. At this point, the subordinate may become overtly obnoxious at times but immediately present a submissive token, if necessary, to placate the aroused and irritated superior. This transition involves a great deal of dominance testing, attention-seeking behavior (active submission), and playful competitive excesses. The alpha may rebuff these excesses but be gradually worn down by the subordinate's relentless and shrewd efforts. As time goes on, a critical point may be reached (especially in socially mature animals) where the provocative subordinate may lose its fear and respect for the alpha altogether and step over the line. If the alpha neglects to act decisively to the challenge, the subordinate may simply take over without a fight. Most often, however, such behavior is met with an immediate and assertive rejoinder, thereby subordinating the challenger (at least for a while). Unless resolved, the two rivals may eventually engage in earnest combat until one is injured, killed, or expelled from the group. These sorts of damaging dominance fights are relatively uncommon in nature but do occur. Serious dominance fights may play a genetic and ecological role in forcing the dispersion of *fit* second-ranking males and females into contact with other similarly expelled counterparts needing mates of their own, thereby encouraging outbreeding and avoiding the dangers of excessive inbreeding between close relatives.

Social Competition, Development, and Aggression

Serious dog aggression problems occur infrequently before the end of the first year and rarely in young puppies. Scott and Fuller (1965) *never* observed any serious attacks or threats in puppies toward humans administering handling tests designed to measure aggressive behavior. Most puppy agonistic behavior is playful, consisting of pawing and inhibited biting actions on hands and clothing. They concluded that "playful aggressiveness and serious aggressiveness are not necessarily correlated" (1965:137)—a finding recently reiterated by Goodloe and Borchelt (1998). Krushinskii (1960), however, has noted research suggesting that some forms of reflexive overt aggression *do* occur in young puppies. In one study, for example, researchers found that a 19-day-old puppy may exhibit an intense aggressive response to being suddenly awakened—a finding that may have relevance for understanding the etiology of this form of aggression in some adult dogs. Although reflexive aggression may be present at an early age, Krushinkii emphasized that "real" aggression toward humans infrequently occurred and not before the end of week 12. Although relatively uncommon, puppies do occasionally present inchoate aggressive tendencies and oppositional behavior that may portend more serious problems in adulthood. It is of great importance, therefore, to identify puppies at risk and to provide them with appropriate socialization and training.

Early Social Learning and Oppositional Behavior

As the result of genetic predisposition and early social learning involving competition with littermates and the mother, a puppy comes into the home *prepared* to accept an affectionate and cooperative (subordinate) place in the family structure, or may bring an enhanced readiness to resist control and assert a real challenge to the family's patience and training abilities. The cooperative and oppositional tendencies of most puppies fall somewhere in between these two extremes. In general, a subordinate or cooperative puppy more readily accepts social control, actively defers when challenged to submit, and exhibits strong bite inhibition, whereas a dominant or oppositional puppy is more likely to defy social control and, when challenged, may resort to aggression, perhaps neglecting to exercise appropriate bite inhibition. Such dominant or oppositional puppies may threaten or snap at family members who attempt to control them, especially around highly motivating activities and resources. The process of establishing control over oppositional puppies can be extremely frustrating and worrisome for novice puppy owners, who may not fully appreciate the potential resistance and persistence of such puppies. This situation is compounded by the owner's sincere desire to affectionately invite the puppy into the home as an equal family member. Unfortunately, affectionate efforts may only lead to unwanted aggressive play and disinhibited mouthing with sharp teeth.

Until the oppositional puppy learns to accept the owner's control and leadership initiatives, it is incapable of forming an affectionate and cooperative relationship. Oppositional puppies may resist instructional efforts to establish household manners, show an unwillingness to accept routine handling and petting, or exhibit intolerance for minimal frustration. In advance of an established leader-follower bond, the oppositional puppy may misinterpret the owner's affectionate efforts, thereby stimulating more social tension and conflict. Finally, early successes involving threats and biting directed against an ineffectual owner may set the precedence for similar behavior in the adult dog. Although it is difficult to make specific predictive statements about the influence of early experience on adult behavior, in comparison to more submissive and cooperative counterparts, puppies exhibiting intolerance for control are likely to continue exhibiting oppositional or aggressive behavior into adulthood unless the problem is addressed with appropriate training. Excessive competition between an oppositional puppy and family members may produce a number of adverse effects:

1. Social aggressive tensions and increased frustration may develop as the result of ineffectual owner efforts to assert control over the puppy.
2. The puppy's perception of social rank may be adversely affected by successfully evading owner control efforts.
3. Evasive chase-and-catch competition over *stolen* objects may be particularly problematical and conducive for the development of aggressive tensions.
4. Abusive punishment occurring out of anger may facilitate the development of defensive aggression.

Although such problems should be addressed and resolved through training, the excessive use of interactive physical punishment should be avoided in favor of positive reinforcement techniques, response prevention, response substitution-redirection, and time-out procedures.

Social versus Competitive (Possessive) Aggression

Competition is a normal aspect of canine social development (see *Social Dominance* in Volume 1, Chapter 2). Competitive success has often been evaluated in terms of a puppy's ability to secure and defend an attractive resource. For example, a common experimental procedure involves giving two hungry puppies a bone or a bowl of food big enough for only one of them to eat at a time. Under such circumstances, one of the puppies will likely displace the other by displaying various aggressive threats or by launching an actual attack, if necessary, to secure control of the bone or food bowl. Under similar circumstances in the future, the loser will tend to exhibit a more deferential pattern of social behavior toward the winner. The value of this procedure for assessing social dominance has been questioned, and some authors (see *Assessment and Identification*) have suggested that social dominance and competitive aggression may actually develop independently and segregate in adult dogs; that is, the dominance aggressor may exhibit competitive (possessive) aggression, but the possessive aggressor is not necessarily dominant and may, in fact, be subordinate in all other situations (Borchelt, 1983). Wright (1980) performed a study designed to evaluate the relation between development, exploratory behavior, social dominance, and competitive (possessive) dominance. In his study, a group of five puppies were tested at three different ages (5½, 8½, and 11½ weeks). The German shepherd puppies showed considerable individual and developmental variations with respect to the expression of social and competitive aggression. Of particular interest was the behavior of the most socially dominant and controlling puppy [no. 2 (male)] when placed into an unfamiliar situation with a littermate and bone. Although otherwise highly aggressive toward littermates, when tested for its ability to control a bone in the novel environment, it scored much lower than less socially aggressive counterparts [e.g., no. 4 (male) and no. 5 (female)], at least during testing done at weeks 5½ and 8½. The two puppies that were most successful in controlling the bone (puppies 4 and 5) in the novel situation were more submissive than puppy 2 when interacting with littermates in familiar surroundings, at least initially. By 11½ weeks of age, however, puppy 2 had become significantly more successful in controlling the bone in the pen situation, superseding the competitive scores of puppy 5 and closing in on puppy 4. Interestingly, puppy 2 also exhibited significant changes in stimulus reactivity and exploration scores at 11½ weeks of age, suggesting the possibility that the puppy's increased competitive success may have been due to a reduction of fear in the novel situation.

The foregoing study does not necessarily support the notion that social dominance and competitive aggression function independently of each other (Reisner (1997). This view represents only one possible way to interpret Wright's findings, but not, perhaps, the most likely one, as Wright points out:

> The relationship between stimulus reactivity and competitive dominance indicates that those puppies that were the least neophobic were also the ones that were best able to control a desirable object in a competitive situation. . . . In other words, the most exploratory and less

> timid puppies were not penalized during the bone-in-pen test by the strange setting, and thus were perhaps better able to control the bone than their more fearful, less exploratory littermates. (1980:23)

The lack of competitive effort exhibited by puppy 2 in the novel setting probably reflects a more general adverse motivational influence rather than the expression of different forms of aggressive behavior. In particular, fear and anxiety (neophobia) associated with the novel setting may be assumed to exert a dampening effect on both appetitive arousal and exploratory activity. In addition, since fear is motivationally antagonistic with aggression, the combined motivational influences associated with the novel setting may have simply suppressed interest in competing over the bone. With regard to the possibility of two forms of dominance (social versus competitive), the study provides no data with which to decide the matter, since appropriate controls were not present to isolate and track such agonistic differentiation independently of the suppressive effects of fear. Fear (neophobia) may generally diminish a puppy's motivation to compete and, in fact, dogs are often more competitive under the influence of familiar surroundings. If puppies had been tested with a bone placed into the home pen, perhaps the apparent differentiation of social dominance and possessive aggression would not have been observed at all. In summary, puppy 2's failure to control the bone in the novel setting at an earlier age may have been due to the inhibitory environmental effects of neophobia over appetitive and aggressive arousal, rather than the expression of different forms of aggressive behavior. Puppy 2's belated success in controlling the bone appears to have been the combined result of maturation and the repeated exposure (habituation) to the novel setting, thus causing a gradual diminution of fear and the simultaneous enhancement of appetitive and aggressive motivation to control the bone.

Temperament Tests and Aggression

Dominant-subordinate relations are formed under the constraints of genetics, maturation, and learning, with competitive relations and incentives changing as a puppy matures. Clearly, the playful competitive sparring between littermates is something quite different from the aggressive contests exhibited by socially mature dogs and wolves. Among adult dogs, for example, competition between adult conspecific males may occur over the possession of an estrus female, something that does not occur among puppies. Although a few constant themes or *individual differences* can be traced out over the course of social development (MacDonald, 1983), the meaning and purpose of competition undergo significant elaboration as an animal matures. The nature of these changes of intention and purpose are defined by biological and social demands placed upon the animal by the interaction of genes, ontogenesis, and environmental pressures. From puppyhood to old age, the direction of these changes is guided by epigenetic processes, incorporating and integrating the aforementioned factors under the selective influence of learning. Developmentally, agonistic behavioral thresholds and corresponding species-typical behavior patterns are strongly influenced by the variable and coordinated expression of genes. The expression of genes appropriate for adaptive success changes as the animal matures. In other words, behavioral traits and abilities appear and become functional according to a genetically orchestrated timetable. The functional influence of genes expressed during the early socialization period is not the same as those influences operating and affecting behavior at puberty or at social maturity. Even cognitive abilities such as *object permanence* are not fully functional in dogs until 11 months of age (Gagnon and Dore, 1994). Genes give structure and order to developmental processes via structural proteins and functional enzymes—enzymes that catalyze biochemical reactions. Enzymes both initiate and regulate the rate of biological activity in every bodily system, including the nervous system, where a precise system of pathways exists between genes, brain structure, neurochemical activity, and behavior (Dewsbury, 1978).

Although an element of continuity certainly exists from conception to senescence, functional elaborations take place throughout the course of a dog's life. These biological

considerations present tremendous challenges for predicting adult behavior based on behavioral tendencies present at earlier stages of development. Over the course of development, genes are variably turned on and off or up- and downregulated under the influence of genes specialized for such purposes. These changes occur in a coordinated manner during a puppy's development. These genetic and experiential influences have important implications for puppy temperament tests and training activities. During early puppyhood, the infant dog's brain and body undergo rapid structural and functional change, reflecting underlying genetic changes controlled by operator genes (turning on or off genes) and regulator genes (increasing or decreasing the activity of genes). Not surprisingly, behavior also undergoes rapid change, and earlier stages of development may not be accurately reflected in later stages of development (see *Temperament Testing* in Volume 1, Chapter 5).

The labile character of aggressive behavior in young puppies makes it difficult to extract any hard and fast predictions about later behavior based on early agonistic indicators. For example, employing a social temperament test believed to perform such a predictive function by some breeders and trainers (Campbell, 1972), Beaudet and associates (1994) were unable to detect a predictive continuity with respect to dominance behavior in young dogs when tested at week 7 and again at week 16. The study involving 39 puppies found that dominance scores at week 7 were not predictive of dominance scores at week 16. The authors conclude that Campbell's test has "no predictive value regarding future social tendencies. In fact, the total value of the behavioral scores for social tendencies between the two age groups showed a trend toward regression from dominance to submission" (1994:273). The authors report that more significant predictive values were obtained by including a measure of activity levels but only in the case of female puppies. Similar predictive difficulties have been reported concerning the value of puppy tests used to help select working dogs (Dietrich, 1984; Wilsson and Sundgren, 1998). Recently, however, Slabbert and Odendaal (1999) reported significant predictive correlations by testing dogs at different ages. In particular, retrieve test scores performed at 8 weeks and the scores of aggression tests performed at 6 and 9 months yielded highly significant predictive values. In combination, the three tests accounted for the prediction of 81.7% of unsuccessful police-dog candidates and 91.7% of those dogs successfully trained for police-dog service.

Perhaps, assessing approach-withdrawal tendencies, emotional arousal (especially fear) and reactivity levels, behavior thresholds, and recovery rates following fear- or aggression-eliciting stimulation at different ages might provide more predictive information about future agonistic tendencies [see Krushinskii (1960), Schneirla (1965), Martinek and Hartl (1975), and Goddard and Beilharz (1986)]. Sympathetic arousal and recovery as measured by changes of heart rate may provide a predictive indicator of temperament, especially with regard to the fear-withdrawal dimension (Fox, 1978). However, even these possibly more stable and heritable indicators undergo significant change over time as the result of developmental consolidation, biological alterations (e.g., hormonal changes), and learning. Nonetheless, assessing behavioral thresholds controlling fear/flight tendencies (passive defensive reactions) and anger/aggression tendencies (active defensive reactions) may provide an objective means for describing and predicting social aggressive behavior in dogs. As discussed in a previous section (see *Behavioral Thresholds and Aggression*), dogs at risk of developing an aggression problem may exhibit at an early age a relatively high response threshold to fear-eliciting stimulation (slow to flight), while showing a relatively low threshold for anger arousal and aggression (quick to fight). As a result, when faced with provocative stimulation, the *excitatory* or active defensive threshold may be triggered before the *inhibitory* or passive defensive threshold is reached. Puppies exhibiting lowered response thresholds for both fear (quick to flight) and anger (quick to fight) are probably at a significant risk of developing serious adult aggression problems involving rage. This risk may be particularly strong in cases in which both fear and anger are evoked at the same time, with the one motivationally cross-associating

and fusing with the other. Under the simultaneous evocation of intense fear and anger, predisposed puppies may exhibit rage (a composite response of escalating fear and anger). As a result of the repeated or traumatic collision of fear and anger, abnormal aggressive behavior may develop (see *Experimental Neurosis* in Volume 1, Chapter 9). As adults, the conditioned or unconditioned elicitation of fear may serve to trigger (rather than inhibit) aggression, thereby releasing a cascade of escalating events in which fear and anger converge motivationally in the expression of uncontrollable rage. In support of this functional etiological analysis, many owners of adult dominance aggressors report a considerable admixture of fear and aggression in the behavioral histories of their dogs.

In addition to puppy tests, temperament evaluation procedures of various kinds have been devised to assess behavioral tendencies in adult dogs. Although the value of puppy temperament tests for predicting adult dog behavior has been challenged, temperament tests for assessing behavioral tendencies of adult dogs are still widely employed and used to help assess and predict future behavior. For example, these tests are often performed to evaluate and certify dogs used in nursing homes to comfort residents and to perform animal-assisted therapy (Fredrickson and Howie, 2000). Unfortunately, most temperament assessment procedures and tests have not been statistically validated for reliability or predictive value (Goodloe, 1996). In a study involving shelter dogs (N = 9) being selected for service work, Weiss and Greenberg (1997) were unable to find a correlation between their performance on an 11-part selection test and subsequent trainability for a service-related task (retrieving). Among tested parameters, they found that fearful submissive tendencies persisted from the initial testing phase into the training and evaluation phases of the study. Interestingly, in one case, a dog passed all test items and was ranked *excellent* but was unable to complete the training phase as the result of excessive excitability and "dominance" behavior. This latter finding underscores the unreliability of inferences about the future absence of some behavior or tendency based on its nonoccurrence during testing, especially in the case of tests not designed to specifically identify and measure its occurrence. In principle, the mere *absence* of some behavior is not a valid indicator of reliability for tests designed to predict behavior, at least insofar as one wishes to avoid running afoul of the *dead-dog rule* (see Chapter 2). Just because some behavior has not been observed to occur in the test or working situation does not rule out its possible occurrence in the future. At best, temperament tests can only reliably predict behavior or analogs belonging to the same general class of behavior observed and assessed during the test. Presumably these identified behaviors are statistically correlated with success in the performance of activities for which the test is applied (e.g., companion dog, therapy dog, or service dog), but even these important data are generally still lacking.

Exploratory efforts have been carried out to validate some behavior tests for identifying tendencies associated with aggression problems. For example, Netto and Planta (1997) have devised a temperament test involving 43 subtests used to identify and assess aggressive behavior in dogs. They report that the test yields significant validation (when compared with the results of owner questionnaires) and a high degree of reliability between test and retest scores involving interspecific attack and snapping directed toward human targets. However, some significant variations were identified between test and retest scores in the case of dog fighting. Intraspecific aggression appears to increase after retesting, suggesting that the dogs may have become less inhibited as the result of increased familiarity with the test area—a finding that has obvious parallels with Wright's study discussed previously. Van der Borg and coworkers (1991) devised and evaluated a series of tests for identifying dogs prone to exhibit a variety of common behavior problems, including aggression. The researchers found that the behavioral tests provided a better means for detecting potential problem behaviors than did the opinions of shelter staff. The opinions of shelter staff were 33% successful in predicting potential problem behaviors, whereas the tests proved to be 74.7% successful in predicting potential problems in adopted dogs.

Prevention

Puppies exhibiting incipient signs of aggression should be identified and referred for appropriate training and behavior modification. Behavior problems caught early enough are often highly responsive to training and therapy; however, as time goes on and they become established, significant change may become progressively harder to achieve: *organization impedes reorganization.* Puppies at high risk are those described by their owners to be difficult, testy, or reactive (quick to show fear or aggression); they are commonly hyperactive, possessive (growl and snarl) over food and toys, competitive and reactive to punishment, engage in habitual *stealing* of forbidden objects that they may then protect or stiffen over, aggressively resist routine grooming or handling efforts, engage in excessive or hard mouthing when touched, and resist basic training efforts. Members of a group at particular risk are those that resent touch and handling (e.g., being picked up) and exhibit other signs of contact aversion. Such puppies may resent even the most gentle petting and handling. While the aforementioned oppositional tendencies should prompt concern, not all puppies exhibiting reactive or competitive behavior necessarily grow up to become aggressive adults; nonetheless, it is important that owners presenting such behavior complaints be encouraged to seek appropriate professional training and counseling for their puppy.

First and foremost, behavior problems are prevented by establishing a human-dog bond informed by a high degree of affection, communication, and trust, that is, interactive harmony. Ultimately, though, preventing aggression problems can be realistically achieved only by genetically improving dogs for close association with people. Genetic improvement depends on selecting and breeding dogs that are less likely to produce overly aggressive offspring. In addition to improved genes, however, dogs need effective training, socialization, and the satisfaction of their basic social and biological needs. All of these considerations are indispensable for ensuring a dog's successful adaptation and the avoidance of adjustment problems—insofar as they are avoidable. Again, in terms of preventing or managing serious aggression problems in vulnerable dogs, considerable benefit can be achieved by initiating early and sustained integrated compliance training and incorporating various behavior modification efforts as needed over the course of the dog's life. Such training helps to modulate behavioral thresholds, reduces interactive frustration and irritability, enhances communication and affiliative cooperation, and promotes affection and relaxation. Finally, such training and socialization significantly improve a dog's overall quality of life, while enhancing the relationship between the owner and dog—the ultimate goals of cynopraxic therapy.

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9

Appetitive and Elimination Problems

For a dog, when he comes to a rosebush or some other shrub, though he cannot urinate, yet he will lift up his leg and make a pretense of doing so.

GEOFFREY CHAUCER, *Canterbury Tales* (1394/1929)

PART 1: APPETITIVE PROBLEMS

EXCESSIVE EATING AND OBESITY

Malnutrition resulting in excessive weight gain or loss occurs when dogs either ingest too much or too little food for their biological needs. If dogs ingest more calories than they need to support biological functions, the excess is converted and stored as fat. As the result of habitually eating more food than is required, the dog's body weight will gradually increase over time. On the other hand, if dogs eat too little food for their needs, fat reserves are gradually depleted and their body weight will decrease.

Definition and Incidence

As in humans, obesity is a common problem among dogs. Obesity can be defined as a condition in which fat reserves accumulate to a point such that the dog's health may be adversely impacted. The extent of the problem has been estimated to affect between 24% and 34% of the dog population (Markwell, 1990), although one practitioner reported that as many as 44% of the dogs visiting an Austrian

small animal clinic were overweight [see Edney and Smith (1986)]—an estimate echoed by Morris and Beaver (1993), who indicate that 44% of the overall companion animal population may be overweight. A dog is considered obese when its body weight exceeds its ideal weight by 15% to 20%, but even excess weight 10% above a dog's ideal weight can have significant health and quality-of-life implications. A simple way to judge roughly whether a dog is underweight or overweight is to observe and palpate its ribs (Sibley, 1984). If a dog's ribs are visible, this is a sign of malnutrition in the direction of inadequate caloric intake, whereas, if the ribs cannot be felt, the thick layer of fat indicates that the dog may be eating too much for its energy needs. Significant evidence suggests that excessive weight gain early in life adversely influences osteoarthritis associated with hip dysplasia. Keeping a dog's weight at optimal levels appears to reduce the severity of radiographic signs of hip osteoarthritis in adult dogs (Kealy et al., 1997). Recently, Impellizeri and colleagues (2000) reported promising evidence suggesting that weight control in adult dogs can significantly reduce observed signs of lameness associated with hip osteoarthritis. The nine dogs, estimated to be 11% to 12% over their ideal weight, lost 11% to 18% of their initial weight while fed a reduced-calorie diet for 10 to 19 weeks. As a group, they showed a steady reduction in lameness over the course of the dieting period.

Feeding and Obesity

Dogs gain weight because they eat more food than they need to satisfy their biological and energy requirements. Of course, this is largely an avoidable problem, since owners control what dogs eat. The causes of overfeeding are varied. Puppy owners are often under the false opinion that a plump puppy is a more healthy puppy and more likely to attain its full size. Consequently, they may overfeed the puppy or supplement its diet in various ways to cause it to eat more than it needs. These efforts may include frequently changing diets, enhancing the ration's palatability by adding canned food or table scraps, and feeding between-meal treats. In some cases, owners may feed a premium diet containing highly digestible food in excessive amounts; however, even in cases where a dog is fed according to the manufacturer's instruction, the dog may still gain weight. Breed, sexual status (spayed or neutered), and health may affect metabolic efficiency or energy expenditure. In addition, food needs vary with activity levels (exercise) and seasonal influences on thermoregulation. Also, despite owner protests otherwise, a little detective work often reveals that a dog is getting additional sources of food besides what is provided in its bowl. For example, some owners may use biscuits to reward good behavior and inadvertently cause their food-trained dogs to become overweight. Small food rewards are usually adequate for training purposes. Further, problems can be avoided by subtracting the amount of food given during training activities from the dog's daily ration. In large families, dogs may receive additional food and treats by begging from different family members. Since only a very small amount of excessive food can result in significant weight gain over time, such incidental sources of food may represent a significant cause of obesity.

Overeating may also result from social facilitation when dogs are fed in close proximity of one another (James and Gilbert, 1955). In some cases, however, close feeding proximity may result in appetitive inhibition and weight loss, especially in the case of dogs that do not get along together on peaceful terms. Mugford (1977) found that feeding a group of dogs on an ad libitum basis (free feeding) significantly curtailed social facilitation, with dogs only infrequently eating together if they had food continuously available to them. In addition to social facilitation, eating excesses may also result from compulsive conflict. For example, Fox (1962) describes an unusual case involving a 12-year-old male Welsh terrier that developed a compulsive eating habit (polyphagia) after a cat was introduced into the household. When in the presence of the cat, the dog ate five times more food than normal. Within 6 weeks, he was grossly overweight and exhibited persistent flatulence. Fox theorized that the dog's excessive eating when near the cat was the result of a summation of appetitive and attention-seeking moti-

vations; that is, in the presence of the owner, attention-seeking behavior and eating behavior became motivationally cross-connected in a compulsive manner.

Metabolic Considerations

In many ways, obesity appears to be more of a metabolic problem rather than an eating problem. Aside from the possibility of a systemic disorders (e.g., hypothyroidism), some dogs simply appear to possess a more efficient metabolic system. As a result, such dogs may be more prone to gain weight because they are better equipped to digest and assimilate more of what they eat while expending a minimal amount of energy doing so. Naturally, dogs with an efficient metabolism would tend to deposit, store, and conserve more fat than counterparts possessing a less efficient metabolism. Evolutionary pressures appear to favor the development of a highly efficient metabolism. A highly efficient digestive and metabolic system would make the most competent use of available food. The storage of fat reserves during times of plenty would help to ensure the animal's survival when faced with adverse conditions of food scarcity or starvation. Under natural conditions, this hypothetical protective mechanism is functional and very useful, since food is not easily and consistently obtained; however, under the superabundance and variety (cafeteria-diet effect) often associated with the domestic situation, dogs may ingest far more food than is necessary for their basic biological needs. The net result is excessive weight gain. In addition to depositing and storing fat, under adverse foraging conditions an animal's metabolism may undergo changes toward becoming more efficient. This adaptive mechanism appears to enhance metabolic efficiency under conditions of starvation [see Brownell et al. (1986)], perhaps helping to explain the tendency of animals and persons to gain weight on a lower-calorie diet or to regain lost weight and more when they go off the diet.

Energy is primarily expended in one of two ways: exercise and heat production. The majority of energy expended by the body is consumed by thermoregulation, with approximately 70% to 85% of caloric energy being used to maintain resting-state metabolism, and the digestion-assimilation of nutrients (Carlson, 1994). Durrer and Hannon (1962) reported a significant relationship between environmental temperature, food intake, and weight gain or loss among a group of Alaskan huskies. Despite eating nearly twice as much food during the winter than during the summer, the dogs tended to lose weight during the cold Alaskan winter months—weight they gained back again during the much warmer summer months. Even under the influence of more modest seasonal temperature changes (Florida), dogs tend to eat significantly less in the summer than in the winter (Rashotte et al., 1984). Although exercise is very beneficial in terms of promoting general health and a sense of well-being, physical activity appears to account for a relatively small number of calories burned. Consequently, weight-loss plans usually emphasize the input (food ingestion) side of the weight problem rather than the output (e.g., exercise) side, but both food restriction and exercise are necessary for effective weight control. In addition to quantity, the digestibility and nutritional density of the food also plays a significant role.

Neurobiological Control of Hunger and Satiety

Another potential cause of overeating is a physiological dysfunction or interference of hunger and satiety signals. Traditionally, opponent set points in the hypothalamus were believed to regulate food intake by inducing hunger (lateral area), on the one hand, and triggering satiety (ventromedial area), on the other (Johnson et al., 1962). Although the lateral hypothalamus (LH) appears to mediate hunger and appetitive preparatory activities via seeking-system circuits, the role of the ventromedial hypothalamus (VMH) in mediating satiety has been found to be more complex than previously believed. In fact, both hunger and short-term satiety signals instructing animals to stop eating probably originate within the LH (not the VMH), whereas the long-term *energy balance system* responsible for regulating food intake appears to originate within the VMH (Panksepp, 1998). Together, these areas of the

brain modulate many aspects of the short- and long-term appetitive-seeking system, thereby keeping energy input and energy output in balance. Under certain conditions, dysregulation of hunger-satiety control may occur. For example, incentive motivation derived from the ingestion of novel or highly palatable food items may overshadow or confound satiety signals, thereby causing a dog to eat more than it needs. Bradshaw and Thorne (1992) suggest that overeating (and undereating), resulting from the ingestion of novel foods, may occur because dogs are unable to predict the nutritional value of the unfamiliar food and do not "know" when to stop eating:

> Most mammals stop eating long before the equilibrium state of the body has been restored, the delay being due to the digestion of many key nutrients, so meal-end must be controlled by some signal that sufficient food has been taken into the stomach. This can only be accurate if the end product of digestion can be predicted, which normally means that the food is a familiar one. Thus both cats and dogs may under- or over-eat if presented with a new food, particularly if it is of a new type; for example, semi-moist food can induce this kind of temporary error when first introduced into the diet. (121)

Whatever the causes, the ingestion of novel food items is believed to facilitate obesity. In the laboratory, a common means to induce obesity is to provide animals with a "cafeteria diet" consisting of a variety of high-energy and palatable food items, thus causing hyperphagia and rapid weight gain (Rothwell et al., 1982).

Significant research has been focused on the role of the neurotropic hormone leptin in the etiology of obesity (Friedman and Halaas, 1998; Friedman, 2000). Leptin is produced by fat tissue and exerts an influence on appetite and fat reserves via leptin receptors located in the hypothalamus. Most of the leptin research has been carried out on mutant obese mice possessing a defective gene needed to produce leptin. When obese mice are injected with leptin, they rapidly lose fat reserves (30% in 2 weeks) by not eating as much and by increasing energy expenditure. In contrast to weight loss achieved by dietary restriction, where both fat reserves and muscle tissue are lost, losses produced by leptin injection specifically target eating behavior and reduce weight by decreasing fat reserves only. Obviously a factor in the regulation of appetite and weight gain, leptin itself may not represent a cure for obesity, however. Obese people, for example, appear not to be lacking in leptin hormone production (in fact, they typically possess much higher levels than lean counterparts) or lack hypothalamic leptin receptors (Panksepp, 1998). The presence of high levels of leptin in obese people suggests that they may produce increased hormone in an effort to compensate for a defect somewhere in the satiety-signaling system (Friedman et al., 1995). The inability of leptin to signal satiety and inhibit eating may be mediated by another gene (SOCS-3), whose expression is turned on in the presence of high leptin levels and inhibits the action of leptin on satiety control centers (Bjorbaek et al., 1998). Finally, Friedman and colleagues have found that dieting results in lowered levels of leptin, perhaps helping to explain the increased appetite, slower metabolism, and weight regain associated with on-again, off-again dieting. Although not a likely cure for obesity, the researchers suggest that leptin may eventually prove beneficial as a means for reducing appetite and helping to maintain weight loss after dieting.

Drinking behavior appears to be under the influence of serum osmotic pressure and blood volume, with drinking being stimulated when serum osmotic pressure rises between 1% and 3% (Wolf, 1950). These changes in osmotic pressure are detected by osmoreceptors in the anterior hypothalamus. Drinking is stopped by a combination of signals, including stomach sensations, dilute blood, and the completion of drinking movements (Johnson et al., 1962).

Owner Attitudes

Kienzle and colleagues (1998) learned that obesity in dogs is affected by the owner's attitude toward the dog and food. They performed a study comparing the personal characteristics and rearing practices of owners of obese dogs with owners of normal dogs. The researchers found that obese dogs were often treated as *fellow humans* by their owners. Also, the owners of obese dogs were often

overweight themselves because of the same lifestyle shortcomings that caused their dogs to become overweight:

> The results of this survey indicate that owners of obese dogs tend to interpret their dog's every need as a request for food. It appears that this is due, in part, to a transfer of their own health and eating habits, including a certain laziness and a lack of appreciation of the dog's nutritional and health requirements. In counseling these owners, they should be encouraged to respond to the dog's requests for attention not always with food, but more frequently with physical activities, such as brisk walks or regular play sessions. There will be benefit for both dog and owner. (2780S)

Inappetence and Anorexia

Dogs sometimes lose weight because of inappetence. Although appetite loss is often associated with medical problems, and should be brought to a veterinarian's attention, anorexia (cessation of eating) is frequently the result of psychogenic causes such as anxiety or separation distress. The suppression of appetite as the result of anxiety can represent a significant obstacle for counterconditioning and training efforts using food. As already mentioned, separation-anxious dogs exhibit a significant loss of appetite when separated from their owners. When left in a kennel for a long time, such dogs may suffer significant weight loss stemming from anorexia.

Dogs may become problem eaters as the result of improving the palatability of ordinary food in order to increase their willingness to eat it. Not only do enhanced diets encourage overeating and possessiveness around the food bowl, they may stimulate dogs to seek even more novel foods. Regardless of what they are given, such dogs may not remain satisfied for very long before they start holding out for something even better. Also, dogs fed savory or varied food items in order to improve appetite may inadvertently learn to manipulate the owner by begging or by abstaining from eating for progressively longer periods. Such dogs may become finicky and refuse to eat ordinary dog food when it is offered to them, especially if it is not mixed with a tasty incentive. A finicky dog can learn to eat regular food again, but only if its owner stays firm and does not yield to the dog's importunate demands for something better. Another possible cause of anorexia in dogs is taste aversion (Houpt, 1982). Following a serious sickness involving nausea, a previously acceptable food associated with acute internal distress may be avoided after the dog recovers.

Pica and Destructive Behavior

Destructive behavior is driven by diverse motivational considerations. A brief inventory of the pertinent factors, includes anxiety, boredom, frustration, attention seeking, nutritional deficiencies, insufficient exercise, hunger tensions, and inadequate training. In addition, destructive behavior is often associated with common diagnostic entities such as separation distress and hyperactivity. Obviously, it is important to assess each case carefully and to determine the likely causative factors involved before drawing premature conclusions and possibly implementing inappropriate or ineffective training. This caution is particularly important with regard to destructive behavior associated with hyperactivity and separation distress (boredom, frustration, and anxiety) and other reactive emotional states.

The term *pica* [after the Latin name for the magpie (*Pica pica*)—a bird reputed to eat a wide variety of things] is used to designate nonnutritive eating of things like cloth, wood, plastics, stones, dirt, or just about anything else a dog can seize with its mouth and swallow. A very common form of pica is grass eating. The causes of grass eating are still unknown but have attracted a range of opinions from a vegetable dietary supplementation, gastric pH regulation, natural purge for worms, and a learned way to induce vomiting when a dog feels nauseous (Beaver, 1981) to perhaps a natural remedy for gastrointestinal irritation (McKeown, 1996). Another common pica habit is chewing and eating stones—which may result in excessive dental wear and gastric obstruction (Fox, 1963). In some cases, this habit may exhibit a compulsive character, as the following anecdote reported by Unwin (1994) seems to indicate:

> The patient was a young male basset hound. Diagnosis was not difficult—he rattled when he moved. After his third gastrotomy I took him out for a walk. Although wobbly from the anaesthetic, when we approached a gravel path he brightened up and attempted to prize a stone out of the ground. (511)

Like other forms of pica, it has been speculated that stone chewing may be related to a nutritional deficiency or malabsorption problem, but this connection has not been experimentally demonstrated. Some puppies and dogs are highly attracted to a variety of household items (e.g., clothing, tissues, paper, toys, carpet matting)—items that may be ingested and cause gastric impaction or bowel occlusion requiring veterinary surgical intervention. Such animals need to be carefully supervised or restrained to prevent such behavior until the underlying causes can be identified and appropriate behavior modification carried out.

Pica is sometimes associated with an underlying medical condition, and therefore its evaluation should include a veterinary examination, especially in cases that involve the ingestion of large of amounts of nonnutritive material. Commonly cited medical causes of pica include a variety of gastrointestinal disorders, including parasitic infestation. Other possible causes of pica include toxins, metabolic disorders, nutritional deficiencies, and neurogenic pathology. Lead toxicosis should be considered as a possible factor in cases where a history of chewing on wood painted with lead-based paint is evident. Lead may also be ingested by puppies that chew or eat newspapers and magazines (Hankin et al., 1974), although such sources of contamination are probably less significant today than they were in the past. Lead, which is a common source of poisoning, may be associated with hyperkinesis, especially in dogs known to have been exposed to lead at an early age. Other behavioral signs of lead poisoning include anorexia, hyperexcitability, compulsive barking, champing fits, convulsions, muscular spasms, and increased sensitivity to touch (Zook et al., 1969). Although pertinent statistics are not available for dogs, 70% to 90% of children testing positive for lead poisoning also have a history of pica (Feldman, 1986).

Some forms of compulsive pica may stem from a malfunction of the limbic system. Bilateral ablation of the temporal lobes in monkeys results in compulsive orality: "The hungry animal if confronted with a variety of objects will, for example, indiscriminately pick up a comb, a bakelite knob, a sunflower seed, a screw, a stick, a piece of apple, a live snake, a piece of banana, and a live rat. Each object is transferred to the mouth and then discarded if not edible" (Kluver and Bucy, 1937:353). The researchers characterized the condition as a "psychic blindness," leaving the animals unable to determine, in advance of placing the item in the mouth, whether it was edible or not.

Nutritional Deficiency

Various nutritional hypotheses have been proposed to explain destructive chewing and other forms of inappropriate appetitive interest or ingestion. Studies of children have found an apparent causal connection between pica and nutritional deficiencies, particularly involving trace metals like zinc and iron. The most frequently cited cause of pica in humans is iron deficiency. For example, among persons exhibiting mental retardation, the frequency and severity of pica are directly correlated with the degree of iron deficiency. In the case of laboratory rodents, iron-deficient rats exhibit 50% lower levels of dopamine (D2) receptors in various areas of the brain. Some authorities have speculated that reduced dopamine neurotransmission is an instrumental neural chemical substrate underlying increased levels of pica activity. Following this line of reasoning, Singh and colleagues (1994) tested the effect of two drugs that have opposing effects on dopamine, one depressing dopaminergic activity (thioridazine) and the other stimulating it (methylphenidate). When given methylphenidate, mentally retarded persons with pica exhibit a sharp decrease in the habit to negligible levels while showing a symmetrically dramatic increase in pica when treated with the D2-antagonist thioridazine. In cases where malabsorption of iron is suspected, vitamin-C supplementation may be beneficial, since ascorbic acid appears to facilitate the absorption of iron (Levine et al., 1999).

Reactive Emotional States and Destructiveness

Dogs appear to engage instinctively in chewing and digging when they are restrained, frustrated, or distressed in an effort to break free or otherwise resolve a stressful situation. For wild canids, chewing and digging are also valuable means for exploring the environment and achieving control over the natural resources needed for survival (e.g., burying and recovering caches of food, uncovering cool earth to enhance thermoregulation, den construction, and foraging on plant matter). Under domestic conditions, these tendencies to chew and dig may become destructive and problematic when they are directed toward personal belongings and carefully planted gardens. In addition, domestic dogs may fall under the influence of various stressors and emotional influences that trigger maladaptive chewing and digging activity. For example, separation anxiety is considered a leading cause of destructive behavior occurring in an owner's absence (Lindell, 1997). Separation anxiety should always be considered as a possible cause in cases were destructive behavior is directed toward door frames, nearby carpeting, and window casings. Such behavior may also be driven by barrier frustration evoked by the owner's departure or outdoor activities (e.g., passing dogs or other animals). Other sources of distress include fear and boredom. Thunder-phobic dogs are prone to scratch and bite on doors and walls when left alone during a storm. Some storm-thunder-phobic dogs routinely flee into closets only to scratch and chew through drywall, sometimes injuring themselves in the process. Finally, simple boredom has been frequently implicated in destructiveness (Voith, 1980; Turner, 1997).

In cases where a stress-related etiology is suspected, the various sources of stress must be identified and addressed with appropriate conditioning, training, and environmental change. Separation-anxious dogs, for example, need help learning to cope with loneliness and distress at separation, frustrated dogs must learn to accept constraining situations imposed upon them, fearful dogs must be systematically desensitized, and bored dogs need to be provided with alternative means for obtaining the stimulation that they crave. Once the underlying causes are alleviated, a dog's destructive tendencies often undergo spontaneous reduction without further training. In some cases, however, a dog may acquire a refractory appetite for destructive activity and consequently fail to stop engaging in the habit, even though the original causes have been removed. Destructive chewing, in particular, may easily develop into such a "vice." In such cases, the object continues to attract the dog's chewing activity and may require inhibitory training or aversive counterconditioning and the redirection of chewing activity into more acceptable outlets.

Pica and Scavenging

Scavenging is a normal canine activity that has served dogs' survival in close habitation with humans for many thousands of years. Current theories of domestication underscore the significance of scavenging for the mediation of close contact between semiwild protodogs and early humans (see *Interspecific Cooperation: Mutualism* in Volume 1, Chapter 1). Most dogs show some degree of interest in scavenging, but some dogs may become virtually obsessed with finding and eating the most unappealing things, at least with respect to the human eye and palate. Scavenging dogs can be extremely frustrating for their owners, making walks a harrowing lunge and yank from one thing to another. Sticks and leaves, rocks, tissues, animal carrion, bits of garbage, everything seemingly draws the dog's fleeting attention. This habit is particularly common in excitable and hyperactive dogs, especially young sporting dogs like the golden, Labrador, and Chesapeake Bay retrievers. The habit should be carefully managed, since improper training could very easily cause a nuisance to escalate into a more serious problem. Such dogs may become progressively possessive and defensive about their prizes, perhaps culminating in embarrassing public affrays over scavenged objects. Many dog owners have been seriously bitten attempting to pry a tissue or piece of plastic wrap from the mouth of their scavenging dog. Possessive aggression problems are frequently traced to competitive interaction over scavenged or

stolen items and the punitive removal of such things from the dog's mouth. The risk of aggression is increased by chasing after a dog that has managed to grab something, especially if it is cornered and forced to release the object. Such activities, while occasionally necessary for a dog's safety, should be avoided whenever possible. Instead of forcefully removing objects from a dog's mouth, the owner should train the dog to trade its prize for a reward.

COPROPHAGY

In many species, such as the rabbit, coprophagy (stool eating) is a normal ingestive behavior that provides a variety of vital nutrients, including B-complex vitamins (Soave and Brand, 1991). Denying rabbits, for example, access to fecal droppings produces nutritional deficiencies and health problems, and, in the case of young rabbits, retards normal growth and weight gain. In the case of rats, 5% to 50% of their fecal output is eaten, providing them with an important source of thiamine and vitamin K. Although dogs do not need to eat feces for good health, when they are fed a thiamine-deficient diet, dogs will engage in coprophagy to stave off physical symptoms and attenuate neurological signs of thiamine deficiency, at least temporarily (Reed and Harrington, 1981). In horses, foals under 20 weeks of age show a preference for their mother's feces, which they eat (Crowell-Davis and Houpt, 1985). A similar phenomenon exists in rats. Rat pups appear to be attracted to maternal feces in order to obtain deoxycholic acid, a chemical that protects them against enteritis and facilitates the digestion and absorption of fatty acids needed for the manufacture of myelin. Finally, equine coprophagy may provide foals with various nutrients (e.g., vitamins and protein) and beneficial bacterial flora needed for digestion (Crowell-Davis and Caudle, 1989). Perhaps similar pheromones and biological benefits are obtained by puppies when they eat feces—a hypothesis that remains to be tested.

Mother dogs instinctively elicit elimination and ingest their puppies' excrement from birth to approximately 3 weeks of age. Particularly fastidious mothers will sometimes continue to "clean up" after their puppies long after week 3, however. Adult males will also ingest feces produced by young puppies. Among wolves, mothers only ingest "milk scats" and refrain from eating fecal material after the puppies begin to eat meat at approximately 3 to 4 weeks of age (Allen, 1979). Although dogs of all ages may show the behavior, coprophagy is particularly prevalent among puppies and young dogs between 4 and 9 months of age. Besides eating their own feces (*autocoprophagy*), some dogs ingest the feces of other dogs and animals (*allocoprophagy*), especially cat and horse droppings. Most dogs actively explore the droppings of other dogs and animals, but, for some dogs, something in the feces is sufficiently compelling and attractive for them to go further and eat it. The texture and smell (taste) of the feces appear to be significant factors. Many coprophagous dogs are particularly attracted to frozen *poopsicles* or firm stools. Such dogs rarely eat soft or poorly formed stools and are less likely to ingest stools that have been rendered objectionable through dietary manipulation or tainted by various repellents.

Coprophagy is considered normal among puppies and represents a small health risk to the offending puppy eating its own feces (Hubbard, 1989), but eating the feces of other dogs may cause parasitic infections (e.g., coccidiosis) or increase a puppy's risk of coming into contact with viral pathogens (parvovirus) shed in the feces. Despite reassurances, owners are often disgusted with the habit and may be unwilling to tolerate it. Many persistent coprophagous dogs have been given up for adoption as a direct result of stool-eating behavior. The problem is especially intolerable in situations where a dog comes into close contact with children, who may be licked on the mouth by the dog. Sadly, some owners may even seek euthanasia in refractory cases—an outcome recommended by some authorities in cases in which the owner's "bond with their is dog irreparably damaged" (McKeown et al., 1988:850) by the habit. However, euthanizing a dog because of coprophagy seems to be a rather extreme and questionable practice.

Putative Causes of Coprophagy

The exact causes of the habit are unknown, but several etiologies have been described. There appears to be some connection between excessive coprophagy and nutritional deficiencies, stress, boredom, unsanitary rearing conditions, and restrictive housing.

Environmental Stress

Overly restrictive or isolatory confinement has been correlated with a higher incidence of coprophagy in dogs. Houpt (1982), for example, has reported that dogs exposed to excessive isolation (kept in kennels or basements) are more likely to engage in the habit than dogs kept in close contact with people. Beerda and coworkers (1999) reported evidence suggesting that restrictive confinement may represent a significant factor in the etiology of coprophagy. In addition, they reported that pica (gnawing behavior) similarly increased among dogs housed under restrictive conditions, suggesting that both coprophagy and pica may be influenced by environmental stress. The dogs (beagles) in the study were first housed under unrestricted (outdoor) conditions before being moved to more restrictive (indoor) housing conditions. The procedure suggests that the causative variable may not be restrictive/isolatory confinement per se but rather points to the possibility that the stressful change and adaptation associated with the transition from outdoor to indoor housing conditions may play a role in precipitating coprophagous activity. In conclusion, at least in some cases, coprophagy may be part of a general pattern of behavioral adaptation to stressful housing conditions, especially those involving increased restriction and social isolation.

Anxiety Reduction and Attention Getting

Anecdotal correlations between coprophagy and various psychological states, such as anxiety reduction and attention seeking, have been suggested but not convincingly demonstrated. Campbell (1975), for example, argues that coprophagy is often exhibited as an anxiety-reducing response acquired as the result of inappropriate punishment during house training or in association with normal fecal interest and exploration. According to his theory, coprophagous dogs choose to eat their feces because it eliminates the *evidence* and the threat of punishment. However, instead of being successful, the act is followed by additional punishment, more anxiety in the presence of feces, and, consequently, more stool eating. Hart and Hart (1985) have speculated about a similar—but opposite—vicious circle. They have noted that some cases of coprophagy may be calculated to attract the owner's attention; that is, eating feces is interpreted as a form of attention-seeking behavior:

> Owners may react emotionally to the sight of their dogs going after feces, and a dog may pick up this reaction as a means to garner additional attention. (107)

Nutritional Causes

A common assumption holds that coprophagy is related to some sort of nutritional problem or deficiency. These theories generally emphasize one of two possibilities: (1) coprophagy is a search for nutrients lacking in a dog's diet or (2) the habit is motivated to consume undigested nutrients passed into the feces. Vitamin-B deficiencies have been frequently implicated. In this regard, Reed and Harrington (1981) note that canine fecal microbial activity synthesizes thiamine and other B vitamins, with coprophagy providing some relief to thiamine-deprived dogs. Landsberg and colleagues (1997) summarized the results of an unpublished study involving nine coprophagous dogs. All exhibited at least one laboratory abnormality that could explain the development of the problem. The majority of the dogs exhibited low to borderline levels of trypsinlike immunoreactivity. Some dogs exhibited abnormal folate or cobalamin levels but none exhibited abnormal fecal fat or trypsin levels. Finally, no evidence of intestinal parasites was revealed by fecal exams. One author claims rapid control of coprophagy by increasing the ration's protein and fat content, reducing the amount of car-

bohydrates, and supplementing with brewer's yeast (Cloche, 1991). Another obvious nutritional possibility to consider, and one perhaps more directly linked with a nutritional function, is that coprophagous dogs may simply be harvesting undigested food passed in the feces.

Enzyme Conservation

Besides undigested food and other nutrients, feces is a rich source of digestive enzymes and bacteria. Whether or not the ingestion of alimentary bacteria is of any benefit to dogs is not known, but some evidence suggests that digestive enzymes may play a role in the control of coprophagy. Many veterinarians and dog trainers report anecdotal success when a meat tenderizer containing papain (a proteolytic enzyme) is added to the coprophagous dog's diet. In the aforementioned report by Landsberg and colleagues (1997), the authors found that four of the nine dogs treated with a plant-based enzyme supplement responded favorably to the therapy. McCuistion (1966) argues that, as the result of living in close association with people, the dog's eating habits and sources of food have changed from a diet proportionately high in animal protein content to one high in carbohydrates and vegetable proteins. He believes these are changes that the canine digestive system has not fully accommodated.

A critical factor influencing a dog's digestive efficiency is the presence of adequate levels of various digestive enzymes specifically designed to metabolize proteins, carbohydrates, and lipids. McCuistion argues that coprophagous dogs eat feces to collect and conserve these critical enzymes, especially those involved in the digestion of carbohydrates and proteins. The theory makes some sense and, perhaps, enzyme deficiency is a relevant factor in some cases of coprophagy. After all, although dogs can survive on a vegetarian diet alone (Thorne, 1996), they are preferentially opportunistic carnivores adapted to eat and digest an omnivorous diet containing a significant proportion of animal protein. Under domestic conditions, dogs are made to eat relatively monotonous diets consisting of high levels of carbohydrate and protein content derived from plant sources. It is reasonable to suspect that some predisposed dogs may exhibit an insufficiency of digestive enzymes needed to digest such food thoroughly, enzymes that they conserve or harvest by eating their own or other animal's feces.

Wolves are particularly attracted to the viscera and contents of the gut, which they eat first—before the more protein-rich and muscled areas of their prey. The canid's predilection to eat gut contents first may have evolved as a means to obtain exogenous digestive enzymes needed to assist in the digestion of gorged flesh protein. Some dogs are particularly attracted to horse manure and apparently relish the opportunity to eat it—could they be seeking similar digestive components? According to McCuistion, some dogs appear to have suffered inadvertent physiological alterations as the result of selective breeding—changes that may reduce the production of proteolytic and other enzymes. Dogs are commonly attracted to cat feces—an interest, again, that may be related to harvesting digestive enzymes or partially digested food passed in the feces.

The enzyme theory is appealing, particularly when one considers that coprophagy is most often exhibited by young dogs. Puppies ingest large amounts of food (proportionately, about twice as much as adults) and might benefit from the supplemental ingestion of exogenous digestive enzymes and partially digested food. If nothing else, perhaps such enzymes and other active digestive aids and nutrients recycled from the stool facilitate the digestive process, making it more efficient and thorough. The central question remains, though: Does a nutritional or enzyme deficiency stimulate dogs to eat feces? Most dogs do not develop coprophagy, even when they are on a less than ideal diet or starved (Crowell-Davis et al., 1995). Also, dogs suffering from pancreatic insufficiency or malabsorption disorder may exhibit such behavior but only after becoming seriously ill and exhibiting other clinical signs of disease. These questions are enough to regard the enzyme theory with some skepticism, at least until additional research is carried out.

Counterconditioning Hypothesis

Associative learning and counterconditioning may gradually supplant an innate aversion and avoidance toward feces and replace it with an appetitive attraction. This process may be facilitated by the habitual association of feces with highly attractive sources of appetitive stimulation. For example, under unsanitary conditions in which excrement is left to lie about a nursery, puppies may be exposed to the odor of feces in combination with three potential sources of appetitive counterconditioning:

–*Food:* Eating in the close vicinity of feces may forge an associative link between its odor and food. This association may cause feces to later become inappropriately identified as a potential food item.

–*Nursing mother:* In situations where the mother is obligated to eat the feces of her young (especially after they begin to eat solid food), the puppies may smell the feces on her breath and identify the odor with food. This may be an especially potent influence in the case of hungry puppies that beg for food by sniffing and licking at the mother's mouth and muzzle. If, at such times, the mother happens to regurgitate food mixed with feces, an even stronger impression may be made—a kind of *appetitive inoculation* may occur that predisposes puppies for coprophagy. Puppies may also learn to eat feces by observing the mother eating it.

–*Exploratory play:* Finally, under filthy and environmentally barren conditions, puppies may play with and ingest feces.

Evolutionary Rationale

Some clues to the origin of coprophagy may be obtained by interpreting the habit in terms of evolutionary fitness and function. In advance of true domestication, early protodogs are believed to have followed nomadic hunting groups moving across Eurasia at the end of the Ice Age. These early dogs were probably scavengers that survived on whatever was left behind in the wake of these vast human migrations. Socially confident dogs had a distinct advantage over fearful counterparts when it came to exploiting discarded offal and garbage. Confident dogs would have been able to approach closer and stay longer near human encampments and, thereby, obtain the most nutritious portions of the refuse left behind. Eating human feces conceivably offered another advantage by providing supplementary enzymes and microbial nutrients supplementing the less than ideal omnivorous diet.

As a consequence of the vicissitudes of domestication, dogs surely fell upon hard times during their long historical journey in the shadow of early humans, at times, perhaps, having little more to survive on than garbage and feces. Eating feces and garbage during times of starvation may have been encoded over time as a genetic trait. Dogs that could subsist on such a diet would have had a distinct survival and reproductive advantage over dogs that refused to eat such things.

An old Crow story, quoted by Lopez (1978), describes habits consistent with those just outlined regarding the feeding behavior of early dogs, including the eating of refuse and human feces, when necessary. The story recounts a dialogue between a dog and a wolf debating the various advantages and disadvantages of domestic life:

> A Crow woman was out digging roots when a wolf came by. The woman's dog ran up to the wolf and said, "Hey, what are you doing here? Go away. You only come around because you want what I have."
>
> "What have you got?" asked the wolf. "Your owner beats you all the time. Kids kick you out of the way. Try to steal a piece of meat and they hit you over the head with a club."
>
> "At least I can steal the meat!" answered the dog. "You haven't anything to steal."
>
> "Huh! I eat whatever I want. No one bothers me."
>
> "What do you eat? You slink around while the men butcher the buffalo and get what's left over. You're afraid to get close. You sit there with your armpits stinking, pulling dirt balls out of your tail."
>
> "Look who's talking, with camp garbage smeared all over your face."
>
> "Hrumph. Whenever I come into camp, my owner throws me something good to eat."
>
> "When your owner goes out to ease himself at night you follow along to eat the droppings, that's how much you get to eat."

"That's okay! These people only eat the finest parts!"

"You're proud of it!"

"Listen, whenever they're cooking in the camp, you smell the grease, you come around and howl, and I feel sorry for you. I pity you. . ."

"When do they let you have a good time?" asked the wolf.

". . .I sleep warm, you sleep out there in the rain, they scratch my ears, you—"

Just then the woman shouldered a bundle of roots, whacked the dog on the back with a stick, and started back to camp. The dog followed along behind her, calling over his shoulder at the wolf, "You're just full of envy for a good life, that's all that's wrong with you."

Wolf went off the other way, not wanting any part of the life. (110–111)

Tolerance for Nausea and Taste Aversion

Of necessity, dogs feeding on refuse would have acquired a considerable tolerance for nausea and other sicknesses associated with the ingestion of spoiled or rotting food. Circumstantial support for this hypothesis comes from the difficulty of establishing taste aversions in dogs (see *Taste Aversion* in Volume 1, Chapter 6). Although some authorities have claimed to achieve positive results by using taste-aversion procedures to control coprophagy (Houpt, 1991; Landsberg et al., 1997), others have been disappointed by the procedure. Hart and Hart (1985), for example, reported "little success" (106) with taste aversion for controlling coprophagy in dogs. Similarly, Rathore (1984) was unable to obtain a lasting taste-aversion effect persisting longer than 24 to 48 hours. In Rathore's study, 10 dogs were given 6 to 10 grams of lithium chloride placed inside various kinds of meat. Not only did the technique fail to yield a lasting aversion, surprisingly, upon vomiting, the dogs actually ate the nauseant-tainted vomitus. Subsequently, untainted meat associated with lithium-chloride-induced nausea was avoided for 7½ hours—a very transient effect. Also, Hansen and coworkers (1997), utilizing a taste-aversion procedure, were unable to control dog attacks on sheep effectively. They did, however, report significant side effects, including increased aggression. Although taste aversion has been reported in a number of species, including coyotes (Gustavson et al., 1974), many dogs appear to be biologically *immunized* against this sort of learning. Bradshaw and Thorne (1992) suggest that dogs may have undergone various changes as the result of domestication that militates against such learning. Perhaps the key alteration was the development of an increased tolerance for nausea. The dogs' historical dependence on less than optimal food sources, including spoiled or rotting food (a potential source of significant nausea), may have resulted in the gradual immunization of a subgroup of the dog population against nausea and the taste-aversion effect. According to this hypothesis, dogs exhibiting an increased tolerance for nausea (evolutionary immunization) may be more inclined to eat feces.

Pro and Con Evidence

Following this line of reasoning, one would expect to find a higher incidence of coprophagy among dogs on an insufficient diet or those showing a failure to digest or absorb food properly. It is noteworthy here that coprophagy is commonly observed in malabsorption disorders or starvation. Interestingly, in this regard, Serpell and Jagoe (1995) report that dogs exhibiting coprophagy are more often obtained off the street or from an animal shelter than from other sources, suggesting that some of them may have relied on feces as a source of nutrition while struggling to survive on their own. Not all the evidence supports this hypothesis, however. In an experiment reported by Crowell-Davis and coworkers (1993), several dogs were put on restricted diets and observed for behavioral changes. Given the aforementioned evolutionary hypothesis, one might expect to find increased coprophagy under conditions of reduced caloric intake. Although restricted feeding had significant effects on activity levels and some other behavioral parameters, there was no evidence of an increased tendency to eat feces by the dogs in the study.

The absence of coprophagy in dogs on restricted diets raises some doubt about the aforementioned hypothesis, but the findings do not necessarily invalidate it. First, the level

of hunger induced by the Crowell-Davis experiment may not have been sufficient to evoke coprophagy. Second, the hypothesis does not assume that all dogs are prone to develop coprophagous habits under the influence of hunger. Third, the hypothesis does not maintain that all dogs show a tolerance for nausea but only suggests that dogs that exhibit coprophagy may possess an increased tolerance for nausea. Before any decisive conclusions can be arrived at concerning the role of domestic evolution on coprophagy, much yet remains to be learned about its etiology.

Encoded Survival Habits

Whatever the causes of the habit, the resistance of coprophagy to punitive training efforts suggests that a very compelling motivational substrate underlies its expression. Consistent with the evolutionary hypothesis already discussed, coprophagy may be one of several appetitive *survival behaviors* that have evolved to cope with the periodic adversity of starvation. Such behavior may be maintained by a very lean schedule of reinforcement, respond atypically to punishment, and exhibit relative immunity to taste-aversion procedures. Consequently, some dogs may persistently scavenge on refuse, bones, and various other nonnutritive items, despite the presence of high levels of punishment and the absence of credible reinforcement to explain the maintenance of the behavior. Perhaps, as the result of some generalized motivational state of agitation (e.g., stressful conflict, frustration, or anxiety) or social need, some vulnerable dogs may exhibit displacement survival behavior despite the absence of actual starvation. In other words, under the influence of chronic stress, scavenging may be emitted as a displacement or compulsive activity. Indeed, pica, in many cases, appears to be driven by a compulsive urge to eat feces or to find, seize, and protect the most inconsequential and nonnutritive items.

PART 2: ELIMINATION PROBLEMS

The first major training chore encountered by new dog owners is house training. Effective house training depends on watchful supervision and the provision of realistically scheduled opportunities for puppies to eliminate outdoors. Most young dogs naturally tend to concentrate the placement of elimination in places away from were they eat and sleep, and readily eliminate outdoors if access is provided to them. Ross (1950) found that puppies rarely eliminated in straw-covered sleeping areas from 5 weeks of age onward, suggesting that the habit of not eliminating in areas used for sleeping begins prior to week 5. By the time puppies are 7 to 8 weeks of age, they begin to exhibit location and substrate preferences (Scott and Fuller, 1965). Such evidence suggests that preliminary house-training efforts should be initiated by the breeder prior to placing the puppy into its new home.

Physiology, Neural Control, and Learning

Elimination is interesting from a behavioral point of view because it involves the coordinated operation of Pavlovian and instrumental mechanisms. Numerous conditioned and unconditioned digestive reflexes are triggered as soon as a bite of food is taken into the mouth. As food enters the stomach, a gastrocolic reflex is elicited that causes increased colonic motility or a *mass movement.* A mass movement is a sustained peristaltic contraction that pushes gut content through the colon toward the rectum, thereby setting the stage for defecation (Berne and Levy, 1996). The structures and mechanisms controlling elimination (defecation and urination) are composed of both striated and smooth muscle tissue. The peristaltic activity occurring on the inside of the rectum is produced by smooth muscle tissue that is regulated by the autonomic nervous system. These internal alimentary reflexes function under the influence of classical conditioning. The anal sphincter, however, is composed of striated muscle tissue that is under voluntary control and subject to instrumental conditioning. In the case of urination, urine moves from the kidneys through the ureters into the bladder. As the bladder distends, a micturition reflex is elicited, stimulating internal and external sphincter contractions and detrusor inhibition (Nickel and Venker-van Haggen, 1999). When the bladder

needs to be emptied, the internal sphincter located within the neck of the bladder is reflexively stimulated to release urine into the urethra. However, the final decision to urinate is controlled by an external sphincter regulated by cortical inhibition (Berne and Levy, 1996). For urination to occur, the external sphincter must be voluntarily relaxed—a process that is strongly influenced by instrumental learning.

In addition to pressure-sensitive bladder reflexes, the dog's urinary activity is strongly influenced by olfactory stimulation. Shafik (1994) demonstrated the existence of an *olfactory micturition reflex.* Electrostimulation of the nasal mucosa results in reduced activity within the smooth muscle of the internal urethral sphincter while producing no response in the external urethral sphincter. The researcher speculates that sniffing urine marks stimulates a readiness to eliminate, despite the absence of a full bladder.

Classical and Instrumental Learning

Both classical and instrumental learning processes interact together in the acquisition and extinction of eliminatory habits. Although reflexive interoceptive stimuli do signal an internal readiness or need to eliminate (establishing operations), these preparatory reflexes are modulated by exteroceptive or external cues that define specifically when and where elimination will take place (discriminative stimuli). Ultimately, a dog's decision to eliminate is an instrumental (i.e., voluntary) act controlled at a cortical level of organization and coordinated by limbic modulatory influences and pontine urine storage and emptying centers (Nishizawa and Sugaya, 1994):

> The cerebral cortex, limbic lobe, basal ganglia, and hypothalamus in suprapontine levels and cerebellum all function in some way which modulates the lower urinary tract function with input-output relationships to the PMC [pontine micturition center]. In this connection, the frontal cerebral cortex initiates voluntary micturition with descending input to the PMC. (169)

O'Farrell (1986) argues that elimination is under the exclusive control of classical conditioning and associated reflexive mechanisms. According to her theory, elimination need not be followed by an *external reward* to encourage the habit:

> Most owners are content if the responses are conditioned to out-of-doors stimuli and not to in-the-house stimuli, but it is possible to condition the responses to much more specific stimuli, such as the gutter or a piece of grass. The practical relevance of the fact that this learning is based on classical conditioning rather than on instrumental learning is that an external reward is not necessary. . . The owner does not need to reward successes or punish failures. (32)

Although it is true that one need not explicitly reinforce elimination habits in order to strengthen them, it does not follow that they are not undergoing instrumental reinforcement. What appears to have confused O'Farrell, causing her to confound reflexive and voluntary eliminative behavior, is a failure to recognize the role of intrinsic reinforcement in the process of acquiring house-training habits. Not all reinforcers controlling instrumental behavior are present as external rewards; in fact, many voluntary behaviors are controlled by intrinsic sources of reinforcement associated with the act itself. Elimination appears to be one of these self-reinforcing behaviors.

Punishment

O'Farrell's assessment appears to have led some behavior modifiers to the fallacious conclusion that inhibitory procedures ought not be used during house training, after all—you cannot punish a reflex. In fact, mild punishment is often very expedient for promoting house training and surely should be applied whenever a puppy or dog is caught in the act of eliminating in the house. Timing is very important when applying effective punishment. The first general rule of effective punishment is that it must occur contiguously with the act of elimination—not minutes or seconds afterward but immediately and overlapping the act itself.

Unfortunately, retroactive or noncontingent punishment is still defended by some dog trainers and is still widely practiced by dog owners (see *Noncontingent Punishment* in Volume 1, Chapter 8). Excessive and inappropriate punishment should also be avoided.

For example, the practice of rubbing a puppy's nose in its urine or feces is often carried out in conjunction with the delivery of a sharp smack to its rear end with a rolled-up newspaper. Such repulsive methods are entirely without behavioral justification, even if the puppy is caught in the act. A startling sound such as a sharp tone of voice or clap of the hands is often a sufficient deterrence.

A dog's cleanliness and responsiveness to house training represents a significant factor in its success as a domestic companion. If dogs were not able to learn to urinate and defecate outdoors on schedule, it is unlikely that they would have attained the close social proximity that they currently enjoy with people. Fortunately, the vast majority of dogs are easily and permanently house trained, often in spite of poorly organized and implemented house-training efforts. Notwithstanding the ease with which most dogs are house trained, some fail to acquire good habits in the first place or develop various behavior problems involving inappropriate elimination as they develop.

Elimination Behavior

Urine Marking

Urine marking is familiar to anyone who has ever spent time around dogs. Intact male dogs are prone to show this activity, expending large amounts of energy on the investigation of attractive spots before urinating over them. Dogs exhibit various searching activities involving sniffing, licking, and sometimes gently scrapping the ground with the front paws, as though to turn up a fresher scent located below the surface. When satisfied with their olfactory inquiry, they appear duty-bound to add a splash of their own to the community *bulletin board.* Some may become rather compulsive about the habit, urinating dozens of times until the effort is reduced to dry *blanks*—a phenomenon that Bekoff (1979) interprets as a visual dominance display. As previously noted, the marking response appears to be mediated by an olfactory micturition reflex (Shafik, 1994). Dogs tend to urinate more often when off leash than when on leash, with both male and female dogs being more likely to defecate when walked off leash (Reid et al., 1984). Interestingly, Reid and coworkers also found that purebred dogs tend to urinate more often than mixed-breed dogs.

Elimination Postures

Male and female elimination postures begin to differentiate along sexually dimorphic lines by 3 to 5 weeks of age, with some male puppies exhibiting a full leg-lift posture by 19 weeks of age (Berg, 1944). Beach (1974) found that urinary postures become sexually dimorphic by 5 to 7 weeks of age, with some male beagles using the leg-lift posture as early as week 16. The discrepancies between Berg's and Beach's observations concerning the onset of leg-lifting behavior suggest that some breed differences may exist with regard to the ontogenesis of the leg-lifting posture.

Another disagreement between Berg's earlier findings and later research is the degree of stereotypy evident in male and female elimination postures. Berg claims to have never observed a female dog elevate her leg during urination. Sprague and Anisko (1973), however describe a significantly different picture with regard to male and female elimination postures. Whereas male dogs were observed to use the elevated leg posture to eliminate almost exclusively (97% of the time), females squatted only 68% of the time, with the remaining 32% of female urinations involving some other variation, including leg lifting. The researchers identified a variety of distinct postures used by males and females to urine mark, including stand, lean, raise, elevate, flex, squat, lean-raise, flex-raise, handstand, arch, squat-raise, and arch-raise (Figure 9.1). Males tend to eliminate more frequently than females. One male dog was observed to eliminate or *pseudo-urinate* 60 to 80 times over a 3- to 4-hour period (Sprague and Anisko, 1973). Usually, females fully evacuated their bladders with one or two urinations. Another prominent difference between male and female urinary activity is its directionality. Among male dogs, urine is most often directed toward the scent of other male dogs, especially involving vertical objects, whereas female dogs tend to be less selective about the

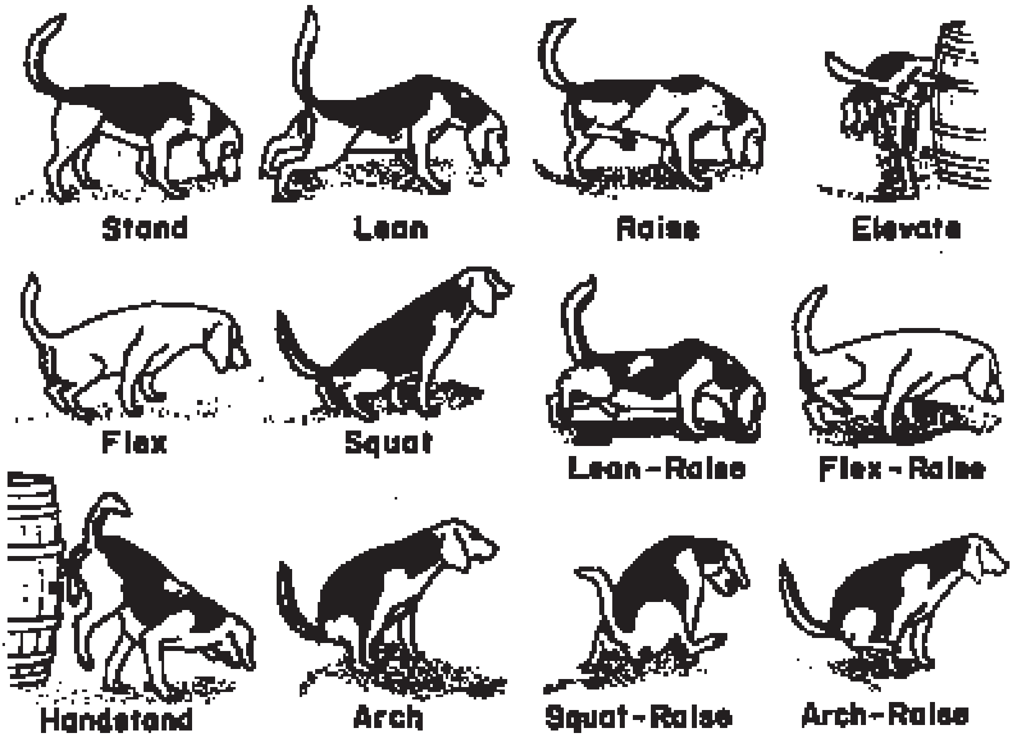

FIG. 9.1. In addition to squatting and leg lifting, dogs exhibit a variety of postures while urinating. After Sprague and Anisko (1973).

placement of urine, suggesting that urination for the female probably is restricted to a physiological function, at least during anestrus. Females were infrequently observed to sniff elimination areas before urinating. Male dogs show a definite preference toward sites frequented by females in estrus and urine-marked sites containing the scent of unfamiliar males (Dunbar and Carmichael, 1981). In addition, Dunbar and colleagues (1980) found that the stimulus value of urine to males was increased when females were injected with the estradiol and reduced when injected with testosterone.

Functions of Urine Marking

Urine marking appears to serve two primary communicative functions: (1) communication between male dogs, and (2) communication of reproductive status between males and females. These social and biological functions appear to be controlled by a hormonally modulated mechanism. Many studies have demonstrated a linkage between urine-marking behavior and the influence of endogenous hormonal activity, but this relationship is problematic. For example, Hart (1974) reported that, although castration reduced mating frequency and the duration of coital lock within 2 months after surgery, the latency and frequency of urinary marking was unaffected by castration after 5 months. Male dogs usually begin to urine mark as they reach puberty, perhaps in response to increasing concentrations of circulating testosterone (Hart, 1985). Although testosterone appears to exert an influence on urine-marking behavior, the behavior does appear to be dependent on the presence of circulating gonadal testosterone. Beach (1974) found that many dogs castrated just after birth (48 hours postpartum) or pre-

pubertally (4 to 4½ months of age) go on to exhibit the leg-lifting posture as adults. Further, he found that castration performed on adult dogs (15 to 17 months) had no observable effect on urine-marking postures.

Despite the relative independence between urine marking and a dog's reproductive status, Hopkins and coworkers (1976) found that household urine marking was gradually or rapidly reduced as the result of castration in about 50% of the dogs surveyed. Consistent with aforementioned reports, they found that urine marking away from the home was relatively unchanged in the neutered dogs:

> Several owners in the present study indicated that urine marking in relatively novel areas (e.g., sidewalks and parks) was unchanged in their dogs, whereas urine marking in the house was eliminated. These differences in castration effects between urine marking in the home and away from the home are probably related to the fact that olfactory stimuli from the urine of other dogs (which are undoubtedly the most important stimuli for urine marking) are strongest outside the home. (1110)

One way that has been proposed to resolve some of these problematic aspects associated with the hormonal mediation of urine marking is to assume that the connection is formed at an earlier point in the animal's ontogenetic development than puberty. In fact, it is known that the fetus is exposed to a significant surge of in utero testosterone secreted just before birth or immediately afterward (Hart, 1985). These androgen secretions serve to masculinize the fetus by producing sexually dimorphic changes in the neonate's brain and various biobehavioral systems. Beach (1974) found that 50% of the females perinatally implanted with a pellet of testosterone tended to exhibit malelike elimination postures. These early hormonal influences may sensitize and promote the development of certain sensory and motor neural connections that are later activated with the onset of puberty. The aforementioned variable responses to neutering, especially the persistence of urine marking in spite of prepubertal castration, may be due, in part, to the formation of such early predispositions.

Common Elimination Problems

House-training problems are a common reason that people seek behavioral advice and training regarding their dogs. Yeon and coworkers (1999) reported that 9% of the cases seen at the Cornell Animal Behavior Clinic between 1987 and 1996 (N = 1173) were house-soiling problems. Voith and Borchelt (1985) reported that approximately 20% of the overall cases presented for behavioral treatment involve elimination problems. Similar statistics concerning the relative incidence of elimination versus other canine behavior problems have been reported elsewhere (Landsberg, 1991), making inappropriate elimination the second most commonly presented behavior complaint after aggression. Few situations generate more frustration than those associated with unsuccessful house training, either because the training efforts somehow go wrong or because a previously house-trained dog begins to eliminate indoors. A variety of elimination problems have been described and classified according to descriptive and functional features (Table 9.1).

Household Urine-marking Problems

Urine marking in the home can be a persistent and damaging habit. Dogs presenting with household-marking problems are often highly excitable and reactive to novelty. Marking behavior is frequently directed toward packages brought into the home (e.g., groceries laid on the floor) or new furniture—the Christmas tree is a prime target for urinary marking. Other dogs may be stimulated to mark in the presence of visiting guests or by the presence of strange dogs coming into the home. Some dogs may mark after observing other dogs or passersby (e.g., the mail carrier) through a window. Occasionally, a particularly dominant dog might exhibit the obnoxious habit of marking people rather than objects. The behavior modifier should attempt to identify the various situations in which marking occurs and then alter the environment or introduce appropriate counterconditioning procedures.

Olfactory cues appear to play a significant environmental role in the maintenance of

TABLE 9.1. Description and etiology of elimination problems

Urine marking: Exhibited most commonly by adult, intact male dogs. Urine-marking dogs usually direct small squirts of urine against vertical objects, especially absorbent couches, chairs, and curtains. Smaller toy breeds most commonly present the problem, but large dogs also exhibit the habit.

Elimination (urination and defecation) in the owner's presence: Inadequate or inappropriate house training may cause dogs to develop a habit of eliminating indoors. A common cause of such problems is excessive crate training and failure to generalize the habit to other parts of the house.

Elimination (urination and defecation) in the owner's absence: Some dogs may abstain from eliminating indoors as long as the owner is present but will eliminate when the owner is away from the home. These cases require careful evaluation, since the unwanted elimination habit may be more directly related to separation anxiety than to inadequate house training.

Refusal to eliminate outdoors: A surprising number of dogs, especially those that have been poorly trained or not trained at all, refuse to eliminate outdoors. Such dogs often hold urine and feces while outdoors or during long walks and then race to their preferred spot upon entering the house.

Excitement elimination: Some highly excitable dogs may lose bladder control during periods of increased arousal or social stimulation. Excitement urination is distinct from submissive urination, although punishment of excitement urination may lead to submissive urination. Excitable dogs may urinate during play or at other times involving intense arousal.

Submissive urination: Young dogs and some adult dogs may eliminate when the owner returns home or enters a room where the dog is located. A submissive dog may also eliminate when guests enter or reach for it. The habit seems to be particularly prominent in females and certain breeds (e.g., the cocker spaniel, golden retriever, and German shepherd).

Fear-related elimination: Some highly fearful and reactive dogs may eliminate in response to strong fearful stimulation. Intense fear is sometimes associated with anal gland evacuation and defecation. Additionally, highly nervous dogs may develop elimination problems associated with diarrhea resulting from increased peristaltic activity.

Dietary etiology: Elimination problems can be traced to dietary causes. These include overfeeding, poor-quality food, the presence of ingredients that cause an excessive intake of water (e.g., excessive salt protein), sudden changes of food, and foods containing large amounts of fat.

Physical causes: Some elimination problems result from structural pathologies of the urinary tract or disease (e.g., renal failure, diabetes insipidus, cystitis, and obstructions). The most common sign of a urinary-tract problem is frequent urination and unusual difficulty to housetrain. Functional incompetence of the urethral sphincter is commonly treated with phenylpropanolamine (Voith and Borchelt, 1996). Urinary incontinence is sometimes observed in spayed dogs. Typically, incontinent dogs leak urine while lying down or dribble it while walking. This problem is caused by an endocrine imbalance which is often treated with hormonal supplementation (e.g., diethylstilboestrol). Older dogs often exhibit a loss of eliminatory control as part of a general aging process and deterioration of central control over the function. Some ongoing research indicates promising benefits resulting from L-deprenyl. Ruehl and colleagues (1994) have reported improvement with L-deprenyl therapy in 16 of 19 dogs with geriatric incontinence.

Genetic predisposition: Some breeds (e.g., beagles, Yorkshire terriers, and bassett hounds) appear to be more difficult to house train or more prone to lose the habit than others.

marking behavior. Dogs are attracted to areas that they have urine marked in the past, perhaps remarking those areas in an effort to keep the odor fresh. It makes sense, therefore, to carefully identify and clean such areas. In addition to scrubbing the area, the owner should also obtain cleaning agents that enzymatically break down residual deposits of urine and kill the odor-producing bacteria associated with it. Melese-d'Hospital (1996) has emphasized the importance of thorough neutralization of urine odors in the treatment of urine-marking behavior problems. Several products are currently on the market for this

purpose [e.g., KOE, Nature's Miracle, X-O and X-O plus, and ANTI-ICKY-POO (a genetically engineered combination of enzyme and bacteria designed to consume urine efficiently)].

Although olfactory cues are important controlling stimuli, they are not the only operative environmental stimuli maintaining the habit. The contextual stimuli associated with the area (e.g., substrate texture, visual cues, and location) may also control eliminatory behavior to some extent. It should be remembered that urination is an intrinsically reinforcing activity; that is, the dog obtains some degree of pleasure or relief as the result of eliminating. Environmental cues occurring contiguously with elimination may gradually become discriminative stimuli regulating the emission of the behavior. Consequently, the olfactory cues contained in urine may only represent a part of an overall stimulus situation controlling urinary-marking behavior.

To counteract these environmental influences, new associations must be formed with the soiled area. This task of forming new, noneliminative associations is accomplished in a variety of ways. The simplest method is to feed and water the dog near the marked area (Voith and Borchelt, 1985). Between feedings, the owner can periodically place treats around the previously soiled area as well, so that whenever the dog approaches the location it is likely to find some food. Chew toys can be permanently anchored to the area with a short length of twine. Another useful procedure is to tie the dog off near the area for short periods lasting between 10 and 20 minutes at a time. The area can also be associated with play, massage, and general obedience training. The central purpose of these recommendations is the formation of a new set of associations connected with the area that are incompatible with elimination. As a result of such training, the previously soiled area may come to be identified as a place promising the acquisition food, toys, affection, training, or restraint. Subsequently, the urge to eliminate will be gradually overshadowed by incompatible expectations associated with the area, making the dog less likely to urinate in the area than before. When the owner is away from home, the dog should be confined so that marking is prevented until the problem is under control.

An intact dog presenting with a persistent urine-marking problem is usually referred to a veterinary surgeon for castration. In cases unresponsive to castration and behavior modification efforts, various psychotropic drugs or hormonal therapy may be prescribed by the veterinarian. A common medical intervention involves treatment with synthetic progesterone (Hart and Hart, 1985). Unfortunately, the beneficial effects of progestin therapy often decay once the medication is discontinued. Since the chronic use of progestins may produce a variety of adverse side effects (e.g., mammary hyperplasia, tumors, and diabetes mellitus), its long-term use is not recommended for the control of refractory urine marking.

Elimination in the Owner's Absence

Some otherwise well-house-trained dogs may eliminate in the house only when their owners are away, while they are in another room, or when asleep. Separation anxiety is frequently associated with such elimination problems, especially when "accidents" only occur shortly after the owner leaves the house (McCrave, 1991; Yeon et al., 1999). Dogs whose house soiling is diagnostically linked with separation anxiety must receive appropriate behavior modification to reduce the underlying emotional tensions associated with the loss of bowel and bladder control. Some separation-anxious dogs appear to respond positively to a change of place when left alone. Elimination problems are particularly prevalent in separation-anxious dogs that are confined to an unsocialized part of the home (e.g., the garage or basement). In general, most dogs appear to find confinement in such areas (especially the basement) aversive and prefer to be confined in more socially active parts of the home. In cases where elimination might be attributable to the place of confinement, the dog should be moved to a more socially congenial area, for example, the kitchen or, perhaps, even crated in a bedroom, especially if the dog is accustomed to sleeping there at night.

Although many dogs eliminate (urinate or defecate) in the owner's absence as the result of separation anxiety, some incompletely house-trained dogs may also selectively eliminate only in the owner's absence or do so secretly to avoid punishment while the owner is at home but out of sight. Incompletely house-trained dogs are given remedial training to help improve their habits. Various other causes of elimination problems have been identified and should be considered when performing behavioral assessments of eliminatory complaints (Table 9.2). Such training usually involves a combination of increased vigilance, confinement, and more opportunities to eliminate outdoors. Dogs that are unable to avoid house-soiling behavior during the day may benefit from the assistance of a dog walker who comes in at midday and then gradually delays the visit by an hour or so each day until the dog can accommodate the longer schedule.

The first step in working through elimination problems is to determine the incidence of the unwanted behavior and other pertinent information. Of particular importance in this regard is the schedule of feeding, type of food fed, opportunities to eliminate outdoors (and outcome), and the time/place of accidents occurring in the house. Consequently, careful feeding and elimination records are necessary in order to determine the explicit character of such patterns and how they might be altered to make training efforts more successful (Figure 9.2). Keeping daily records and logging outdoor opportunities often provide unexpected information that may not be obvious through casual observation alone. Such records provide the owner with orderly feedback concerning the dog's elimination behavior and an objective means for assessing its daily progress. Remedial house training can be an extremely frustrating process, and such records objectively show patterns of improvement (or lack thereof) and help to diffuse some of the emotional tensions associated with the process.

Occasionally, in the case of multidog households, it may be difficult to ascertain which dog is responsible for urinating in the owner's absence. Separating the dogs is an expeditious way to identify the dog responsible. However, when separation is not possible or practical, another method may be used to discover the culprit (Karofsy, 1987). The determination can be made by giving the suspected dog a tablet of aspirin before a meal. Within a short period, urination will contain traces of salicylate. When a urine spot is found, it is extracted with a paper towel and ferric chloride is applied to it. If the urine contains the salicylate contaminant, it will turn a burgundy color.

Crate confinement is often recommended to facilitate good eliminatory habits. Although close confinement usually inhibits elimination in most dogs, some dogs may continue to urinate or defecate even when confined to crates. Excluding separation anxiety and health problems [see Reisner (1991)], the most common causes are related to the size of the crate or the amount of time the puppy or dog is required to spend crated between outings. Crates that are too big may not promote fastidiousness, but even if the crate is sufficiently small, some dogs may still eliminate when confined. A contributing cause for this failure is a history of excessively lengthy periods of crate confinement, which exceed the dog's ability to hold. In essence, such confinement presents an uncontrollable situation in which elimination is physiologically unavoidable, perhaps promoting a progressive state of learned helplessness with respect to eliminatory functions. Repetition of such treatment may lead a puppy to simply give up trying to hold urine or feces. Since the effort to hold is useless and progressively uncomfortable, the puppy may respond to the earliest internal signals of need and eliminate withoug trying to hold for long.

Another common difficulty involves dogs that refuse to eliminate on walks or malinger when let outside. This problem is exasperating for the owner, who may walk the dog for long periods, only to return home and discover that the dog quickly runs off to a favorite location in the house to eliminate. Such dogs appear desperate to eliminate but are unable to do so outdoors. Some dogs may have developed overly exclusive substrate or location preferences, whereas others may fail to eliminate outdoors (especially if the owner is nearby) as of the result of a history of excessive punishment,

TABLE 9.2. Common causes of elimination in the owner's absence

Inadequate or inappropriate training
Separation distress
Elimination inhibitions (e.g., fears associated with the outdoors, weather aversions, overly exclusive substrate preferences, and fear of eliminating in the owner's presence)
Irregular scheduling of feedings and outings
Insufficient opportunities to eliminate outdoors and too much freedom to eliminate indoors
Quality or amount of food fed to the dog
Urinary-tract disease (e.g., cystitis)

HOUSE-TRAINING DAILY LOG

WEEK	AM	PM
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

Notes

Note the time of opportunity and outcome. Also, indicate the time and place of all incidents of house soiling. (D) Defecation (U) Urination (D/U) Defecation and Urination (A) Accident

FIG. 9.2. House-training daily log.

causing them to generalize the threat of punishment across both indoor and outdoor contexts. These dogs may simply be afraid to eliminate in close proximity with the owner. Giving them more room to move about in a fenced area or exercising them on a long line may help to encourage outdoor elimination, especially if they are prompted with a gentle voice and rewarded with treats for performing. Other dogs may have simply been improperly trained in the first place. To modify these types of problems, the puppy should be taken out at times of greatest need (e.g., in the morning) for brief periods lasting about 1 to 3 minutes (adult dogs, 3 to 5 minutes). A puppy that fails to eliminate is taken back inside and crated or tethered for 10 or 15 minutes and taken outside again. This pattern is repeated until the dog performs outside, whereupon it is reassured with praise and affection. Urination and defecation in such cases can often be facilitated with brief periods of ball play or other vigorous activities that help to promote motility and disinhibition.

Submissive Urination

Submissive urination is most commonly exhibited by young dogs and appears to be more prevalent in female dogs. In most cases, dogs gradually grow out of the problem as urethral sphincter control improves; however, some highly sensitive and excitable dogs may continue to urinate submissively into adulthood, especially if the initial presentation of the problem is mismanaged. Submissive urination is evoked by a variety of social situations: (1) when the puppy or dog is reached for or (2) leaned over (in what might be perceived as a threatening gesture or posture), or (3) during episodes of excited social interaction (e.g., greetings). Submissive urination appears to represent an appeasement display and is often exhibited by a puppy or dog that has been exposed to inappropriate punishment or excessive control efforts; that is, the behavior may be expressed to allay a perceived threat posed by the presence of an overbearing owner, person, or other dog. The behavior may be maintained by negative reinforcement, since it causes the owner to withdraw as urination occurs. Even worse, though, sometimes submissive puppies are punished for urinating, causing them to urinate even more—an action that is also frequently associated with the termination of the owner's punitive efforts. Unfortunately, in such cases, the habit of submissive urination may be strongly reinforced, thus becoming progressively more exaggerated and difficult to resolve. Some cases of submissive urination appear to be linked to punitive interaction early in a puppy's development—for example, during house-training efforts when the puppy is physically punished while eliminating. During such interaction, the puppy may make a rapid transition from functional urination to submissive urination in response to the owner's inappropriate punishment. Consequently, as the owner leans over, reaches for, or touches the puppy, it may respond by urinating.

Although submissive urination is frequently driven by appeasement motivations, it is not always and exclusively due to excessive punitive interaction between the puppy and its owner. Some puppies appear to be predisposed to exhibit this habit spontaneously as the result of excitement and urethral incompetence but usually grow out of it—provided that they are not punished for it.

Submissive urination occurs most commonly during social transitions, that is, during homecomings or while greeting guests. In some cases, the mere sight of a particular family member entering a room may elicit a copious release of urine. The most common posture displayed is an incomplete squat with small amounts of urine being expressed, but some dogs may perform a full squat or actually roll on their side (lateral recumbency) and expose their belly before eliminating. Other signs of submission may also be present (a submissive grin, licking, ears back, or a crouched-down look), but these submissive elements are not always strongly presented.

Submissive urination probably stems from the mother's practice of stimulating reflexive urination in puppies. Fox (1974) has described the relationship between reflexive urination and submissive behavior:

> When two adult dogs or wolves make social contact with each other, one invariably orients

> toward the groin of the other. Groin presentation is usually manifested by the subordinate individual. As a social gesture, it is perhaps analogous to a handshake in man. The next time you see a friendly dog approaching you, notice how he wiggles his head and swings one hip around, presenting the groin. If you touch him in the groin, he will remain completely passive and may even roll over onto one side in complete submission. He may then urinate submissively. Submissive urination is the final clue to the ontogenetic history of this behavior. When wolves, coyotes, and dogs are very young, they are unable to urinate, and the mother reflexively stimulates urination by licking the genitalia. During stimulation the pups remain passive while the mother nuzzles the groin region. Later, of course, the animals are able to control urination voluntarily, but the behavior trait of remaining passive when the groin is touched persists as part of their social repertoire. (42)

In fact, many infantile behaviors involved in nursing, food getting, and elimination appear to be elaborated into mature active and passive submission displays.

Many adult submissive urination problems appear to stem from an emotional etiology. Puppies and dogs with highly excitable temperaments, which exhibit approach-avoidance conflict during greetings, appear to be most prone to exhibit the problem. The treatment of submissive urination begins by carefully identifying eliciting stimuli. Sometimes the reaction to people is specific to one sex, with some dogs urinating only in the presence of males and not females or vice versa. Some dogs have such a low threshold for submissive urination that they respond as soon as the owner or visitor enters their personal space, whereas others may urinate only when being reached for, leaned over, or touched. As just noted, in the case of young puppies (under 16 weeks of age), this is a common and normal habit that usually disappears with maturity. In older puppies and adult dogs, the habit may become more persistent and compulsive, requiring carefully structured behavior-modification efforts to resolve it fully.

Gradual exposure and counterconditioning prove extremely effective in reducing submissive urination. In the typical scenario, the owner is instructed to give the dog a treat on every approach, at first tossing the food on the floor and then gradually requiring the puppy to sit and stay a moment before delivering the reward. Besides eating, the dog can be engaged in other activities such as fetching a toy or, perhaps, taken directly outdoors. This process is facilitated by repeated exposure involving mass trials; that is, by staging repeated contact rituals involving as many as ten approach and withdrawal trials per session, the exposure-counterconditioning process is made more effective. In the beginning, the owner should avoid leaning over or reaching for the puppy or dog. As progress occurs, more obtrusive actions like reaching and leaning over the dog can be attempted, first while the puppy is eating, later while holding a sit-stay, and, finally, under progressively more natural circumstances occurring during actual greetings with family members and guests. In refractory cases of submissive urination, a pharmacological intervention might be considered. Some success has been reported using the alpha-adrenergic agonist phenylpropanolamine—for further information, see Marder (1991) or Voith and Borchelt (1996). The muscles of the urethra are adrenergic, and the drug enhances general tone and control so that, when the dog becomes overly excited or squats, it is less likely to lose control. The drug has potential side effects, such as increased excitability and restlessness. Marder (1991) reported good results using imipramine (Tofranil), a tricyclic antidepressant that also possesses alpha-adrenergic agonist properties.

Defecation Problems

When defecation problems present separately, the usual causes include inadequate or inappropriate house training, separation-related distress, change of diet, or disease conditions affecting the bowel (Reisner, 1991). As already noted in the case of urine-marking behavior, defecation may occur in the house in response to environmental cues that have been associated with defecation in the past. Although dogs do not appear to use feces to mark in the same manner and frequency as

they mark with urine, some do show a tendency to deposit fecal material on vertical objects, suggesting that fecal marking or advertising may occur in some dogs. Few dogs show as much interest in the fecal deposits of other dogs as they exhibit toward urine-marked areas. Anal fluids are secreted into fecal materials as defecation occurs. The exact function of anal secretions is unknown, but they may contain some pheromonal information that is communicated in the feces. In wolves, alphas secrete more anal fluids during defecation than other pack members and tend to concentrate their feces to one area (Asa et al., 1985). One authority has suggested that the dog scratches after defecating in order to spread the scent of feces. This possibility is unlikely, however, since dogs rarely disturb feces with their feet while performing the scratching ritual. Wolves appear to step away from fecal deposits deliberately before scratching (see *Biological and Social Functions of Smell* in Volume 1, Chapter 4).

FLATULENCE

Flatulence is a common complaint. Dogs fed a new diet may develop flatulence, at least until the gut adapts to the change. Some breeds appear to be more prone to the problem than others. For example, brachycephalic breeds frequently have the problem, perhaps because such breeds ingest excessive amounts of air (*aerophagia*) while eating. Aerophagia appears to be a significant cause of flatulence in both dogs and people (Hubbard, 1989). Since dogs ingest more air while eating a liquid diet, changing to a dry kibble may be beneficial in such cases. Another significant cause of flatulence is bacteria fermentation in the lower gut. Undigested food undergoes bacteria fermentation in the colon—a process that increases gas production. Older dogs may be more prone to exhibit flatulence due to an age-related decrease in colonic motility (constipation) and increased fermentation time. Foods that may contribute to flatulence are those containing a high percentage of indigestible fiber (e.g., soybeans). Also, milk may cause flatulence in adult dogs bereft of lactase as the result of the putrefaction of lactose in the gut. In addition to dietary changes, exercise is a useful way to reduce flatulence, because it increases colonic motility and stimulates more bowel movements. Finally, excessive flatulence may indicate the presence of gastrointestinal disease (e.g., malabsorption and exocrine pancreatic insufficiency) and should be brought to the attention of a veterinarian.

GRASS BURN AND URINE

A common complaint of dog owners is the presence of burned spots or dead areas of grass caused by urination. Various putative causes have been suggested, especially the belief that dogs urine is either excessively acidic or alkaline. In fact, the relative acidity or alkalinity of the dog's urine has no effect on its propensity to burn grass. Consequently, it is of little value to feed dogs substances with the intention of reducing the acidity or alkalinity of their urine output. Similarly, putting such materials as gypsum or lime on the grass probably does not help either, at least with respect to neutralizing urine and making it less hazardous to grass. According to Allard (1981), the most likely cause of grass burn is the nitrogenous content of urine. Urine burns grass just as excessive fertilizer would damage it. Since the nitrate content of urine is related to the metabolism of proteins and associated waste products, one potential way to reduce the extent of grass burn is to reduce the intake of dietary protein. In fact, many dogs ingest protein in excess of their activity and physiological needs. A high-quality, reduced-protein food may not only be an effective preventive for lawn burn (especially in the case of resistant grass varieties), but it may also be a healthier diet for inactive house dogs. Also, providing dogs with ample drinking water may produce a beneficial effect by diluting the urinary output. A simple way to prevent grass burn is to walk the dog away from the home property. The dog can learn to treat the yard and garden as extension of the home and keep it clean. If such training is impractical, then daily watering of urine-soaked areas may be helpful. Allard reported that, when urine spots were watered up to 8 hours after elimination, burning was prevented (fescue),

whereas urine left undiluted for 12 hours caused a slight burn, and, after 24 hours, a lack of watering resulted in moderate burning. Some grass varieties are more resistant to urine burn than others. For example, fescue and rye grass were found to be the most resistant to urine burn, whereas Kentucky bluegrass and Fairway crested wheat grass were both very sensitive and burned, even in the presence of highly dilute urine samples.

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10

Cynopraxis

Ultimately, the dog, with its ambiguous roles and cultural values, its constant presence in human experience coupled with its nearness to the feral world, is the alter ego of man himself, a reflection of both human culture and human savagery. Symbolically, the dog is the animal pivot of the human universe, lurking at the threshold between wildness and domestication and all of the valences that these two ideal poles of experience hold. There is much of man in his dogs, much of the dog in us, and behind this much of the wolf in both the dog and man.

DAVID G. WHITE, *Myths of the Dog-Man* (1991)

CYNOPRAXIC COUNSELING

Although descriptive and functional information is useful, its effective and humane implementation depends on properly focusing intervention efforts. For behavioral intervention to work, the *whole picture* must be embraced and kept in focus throughout the assessment and training process. This method is referred to as *cynopraxis.* The ultimate goals of cynopraxic assessment and training are determined by two imperatives: improving the human-dog relationship while raising the dog's quality of life (see *Cynopraxis: Training and the Human-Dog Relationship* in Volume 1, Chapter 10). Analyzing the behavioral complaint into specific functional components (establishing operations, discriminative stimuli, elicited and emitted behavior, and controlling consequences) and the numerous molar relations existing between them is not enough. In addition, cynopraxic counselors must be sensitive to subjective and intuitive considerations associated with the human-dog bond—ultimately the focus of all training and counseling efforts. Behavioral approaches that neglect a dog's physical and psychological needs or fail to appreciate the ultimate value of the human-dog relationship are incomplete, inadequate, and inhumane. Whether adaptive or maladaptive, a dog's behavior is acquired or extinguished by way of interactive exchanges and transactions interfacing or colliding with human needs and expectations. Within the context of a shared home, these combined human-canine needs and expectations are

either mutually satisfied or result in conflict, with an inevitable elevation of interactive tension (anxiety and frustration) ensuing. Excessive anxiety or frustration underlies the development of many behavior problems (see *Learning and Behavioral Disturbances* in Volume 1, Chapter 9). Interactive harmony depends on the identification of a dog's basic needs and developing acceptable and cooperative ways to satisfy them. Dog behavior problems are human-dog problems. Sensitivity in this area makes the difference between mastery and mediocrity in the practice of companion-dog training and behavioral counseling.

Attaching, Bonding, and Relating

A cultural and ethical ambivalence informs the way animals are viewed and treated in our society. Animals are slaughtered for food by some people or honored as symbols of piety and mystical transcendence by others, and at times serving both purposes at once, as in the case of animal sacrifice. Our relationship with dogs is also guided by many conflicted cultural purposes and agendas (see *Theories of Pet Keeping* in Volume 1, Chapter 10). Adding to the confusion is the lack of a consistent terminology for describing the human-dog relationship. Scott (1991) notes that the terms *attachment* and *bond,* for example, are loaded with surplus connotations and often inappropriately used to describe the same phenomenon. However, attachments and bonds are qualitatively different and distinguished on a number of levels. Unlike bonds, attachments can be equally felt toward animate objects (social) and inanimate objects (places and things). Attaching to some object or place does not require mutual exchange between individuals. A bond, however, implies the existence of mutual *ties* between individuals, based on various modes of reciprocal interaction and relating to one another (e.g., transactions and exchanges). Further, bonds are not based entirely on friendly or affiliative transactions and exchanges. In fact, bonds may be strongly influenced by the exchange of aversive transactions and subsequent reconciliations. Bonding may also be enhanced by the exchange of threat and appeasement displays. Finally, exchanges between bonded individuals involve a strong interpretive component based on past experience, mutual expectations, and their changing motivational disposition to interact. These collective attitudes and expectations define the relationship, and the range of possible exchanges and transactions that can take place, between a dog and others with whom it is bonded and interacts.

Cynopraxis and the Human-Dog Bond

The most fundamental unit of cynopraxic analysis is the *human-dog dyad.* A central cynopraxic assumption is that behavioral and emotional problems develop within a system of relations between a family and its dog. People and dogs relate to each other through the exchange of attractive and aversive emotional transactions. These interspecies emotional transactions, the basis of human-dog communication, result in an alteration of both human and canine feeling states, experienced simultaneously inwardly (within the self or organism) and empathically (toward the other). The formation and perpetuation of the human-dog relationship places tremendous demands on a dog's adaptive resources. Under conditions in which these demands exceed a dog's ability to adjust (e.g., under the influence of unpredictable or uncontrollable transactions), the dog may revert to rigid emotional or instinctual systems with which to guide its behavior. Relational conflicts result in varying degrees of anxiety or frustration, with resultant disturbance of behavioral adaptations. Under interactive conditions in which anxiety and frustration levels surpass a dog's ability to cope, it may progressively rely on rigid emotional or species-typical defensive repertoires, thereby side stepping cognitive appraisal of the situation and responding instinctively or dysfunctionally. Consequently, the dog's behavior may become progressively maladaptive, fearful, compulsive, hyperactive, or aggressive.

These functional disturbances of the human-dog relationship take place within the context of a home. Ultimately, the functional significance of a behavior problem is determined by the extent to which it interferes

with a dog's ability to form satisfying relationships with humans and other animals with whom it shares a home. Cynopraxic therapy objectifies the human-dog relationship as the functional unit of behavioral adaptation or maladaptation, set within a context of numerous contributory environmental influences (e.g., nutrition, exercise, and sensory stimulation). These environmental influences composing a dog's *home* collectively define its quality of life. Cynopraxic training aims to enhance the human-dog relationship while simultaneously improving the dog's quality of life. The cynopraxic process is an end in itself, insofar as there are no objectives beyond the attainment of human-dog harmony, mutual appreciation, and well-being.

Behavior Problems and the Family

For purposes of the following discussion, the term *family* refers to any cooperative social group of individuals that lives together and provides for one another's physical, psychological, and emotional needs by forming bonds based on reciprocal transactions and exchanges within the context of a home. The family is not defined or limited in terms of biological relatedness but in terms of emotional and ecological relations sustained within a home. The family may be as simple as a single owner and dog dyad or include complex social relations, as, for example, found in the traditional nuclear family. Whether traditional or nontraditional, many family dynamics and activities are patterned around the dog as an emotional center of gravity.

The mélange of social roles that the dog plays in the family underscores its behavioral adaptability to domestic life. According to Levinson (1969/1997), a dog's role will depend "upon the family's structure, its emotional undercurrents, the emotional and physical strengths and weaknesses of each of its members, and the family's social climate" (122). In most families, the dog is an important object of affection, care, and entertainment—often taken for granted but nonetheless accepted as a beloved member. A dog's presence in the family is harmonious and welcome to the extent that its behavior is well adjusted to the family's needs and expectations. With the advent of a serious behavior problem, however, intense conflicts may compete with or overshadow the more positive aspects of dog ownership. For the family, a problem dog becomes a highly *objectified* presence often precipitating a sense of disequilibrium and familial crisis. As a result, the dog moves out of the fluid background of harmony into a sharp focus of attention, becoming the object of conflict and disruption for family members.

Much of what follows has been adapted from the contextual therapy techniques developed by Ivan Boszormenyi-Nagy (Boszormenyi-Nagy et al., 1991) but remains an eclectic composite containing many influences, especially prominent is the work of Salvador Minuchin (Minuchin and Fishman, 1981) and Murray Bowen (Papero, 1990). The primary emphasis of cynopraxic training is to focus training efforts on the relationship, rather than on simply altering the dog's behavior.

The response of the family to a problem dog varies, depending on several factors. In some dysfunctional family situations, a problem dog may have a disruptive and polarizing influence, with the dog becoming a scapegoat for displaced anger. Rather than searching for legitimate causes and solutions, the dog's unwanted behavior may be used by family members to shame one another. In some cases, a serious behavior problem might actually provide some degree of stability and cooperation within an otherwise conflicted and tenuous family situation. In such cases, the problem dog may give the family a common crisis point, drawing members together in a more or less common cause. Although dysfunctional situations exist (see below), one is much more likely to encounter functional families seeking advice and training for problem dogs. Generally, such families tend to adopt a rational perspective when faced with adversity. In contrast to the arguing and scapegoating that characterize a dysfunctional family, a functional or parenting family is more apt to join together in a cooperative

effort, with each acknowledging their responsibility to contribute to the ultimate solution. Rather than assigning blame, the parenting family is galvanized by a supportive sense of unity and mutual appreciation and respect for one another.

Joining the Family

Although the causes underlying a dog's adjustment problem may implicate the client or another family member, it is important to provide such information without assigning blame. Direct attributions of fault and blame are always polarizing and destructive. Most dog owners seeking help seem to expect some criticism, but framing a behavior problem in terms of fault finding is not the same as exploring potential causes or fact finding. Any potentially critical evaluations should be presented in a manner that is nonaccusatory and followed immediately by positive alternatives. First and foremost, one should avoid direct critical commentary on the family's failings with respect to the dog. Instead of shaming the family, positive resources should be highlighted through merit ascription, recognition of needed abilities, and encouragement. To achieve this end, it is vital that the trainer-counselor *joins* with the family. Minuchin and Fishman (1981) describe the process of joining the family in terms that are highly relevant to the cynopraxic counseling process:

> Joining a family is more an attitude than a technique, and it is the umbrella under which all therapeutic transactions occur. Joining is letting the family know that the therapist understands them and is working with them and for them. . . .. How does a therapist join a family? Like the family members, the therapist is "more human than otherwise," in Harry Stack Sullivan's phrase. Somewhere inside, he has resonating chords that can respond to any human [or animal] frequency. In forming the therapeutic system, aspects of himself that facilitate the building of common ground with the family members will be elicited. And the therapist will deliberately activate self-segments that are congruent with the family. But he will join in a way that leaves him free to jar the family members. He will accommodate to the family, but he will also require the family to accommodate to him. (31–32)

A trainer-counselor who joins the family while blaming and shaming it (regardless of how expert and correct) for the dog's behavior problem may be reflexively held at a distance or expelled psychologically—if not physically! Direct criticism may cause the family members to withdraw into defensiveness and potentially strengthen their own scapegoating tendencies toward one another. The goal is to find and acknowledge as many constructive aspects of the family's interaction with the dog as possible and to build on that foundation. Validation of the family by acknowledging its affirmative value and contribution to the dog's good qualities is beneficial on many levels. The process draws heavily on a spirit of family cooperation and provides an opportunity for members to sacrifice and compromise to attain some greater good for the sake of the group and the dog. It is a process of building on the dog's good behavior rather than a fruitless labor of accusation and penance. Nonjudgmental and fair counselors are better able to establish a working rapport with families and gain their willing and happy collaboration. Furthermore, family members will more likely extend their trust and disclose vital information necessary for an accurate evaluation. By emphasizing the positive aspects of the family dog, an opportunity to strengthen the family's commitment and loyalty to the dog may be garnered, perhaps helping to restore a healthy bond and attachment rather than risking further marginalization of the dog.

In some cases involving severe behavior problems, the relationship between the family and dog may be seriously jeopardized by anxiety, frustration, anger, and resentment. In such cases, it is particularly important to review all of the dog's merits and strong points in order to forge a constructive perspective on the problem situation. For some clients, it may be necessary to underscore the dog's strong points repeatedly and to stress the successes that they have achieved in rearing and training it. Emphasizing what makes the dog special and complimenting these strengths can be very useful. Also, it is of value to acknowledge the client's entitlement to feel angry and resentful but at the same time pointing out to them that rumination

on such feelings is unproductive and may interfere with the dog's progress.

The cynopraxic trainer-counselor's role is first and foremost one of model and leadership. The counselor should exemplify in a direct and personal way how to behave constructively toward the dog, while stressing fairness by not becoming overly partial toward the dog or the family. Although many technical issues are involved in rehabilitating a problem dog, the overall manner or attitude of the counselor is often more influential than any specific recommendation. The trainer models the spirit of the thing in attitude and interaction with both the family and the dog. Essentially, the *work* of trainer-counselors is to resolve *conflict* in the family-dog relationship and restore interactive harmony through training and counseling. From the cynopraxic point of view, the ultimate goal of intervention is not training a dog to sit on command or to stop some unwanted habit but rather to mediate interspecies understanding, behavioral compromise, and interactive harmony—a process that may or may not involve obedience training or behavior-modification efforts.

Fairness and Empathic Appreciation

A central variable informing interactive harmony is a relational ethics based on fairness and empathic appreciation. Boszormenyi-Nagy and colleagues (1991) emphasized the role of fairness in the process of counseling the family: "The balance of fairness among people [and animals] is the most profound and inclusive 'cluster' of relationship phenomena. This is the context to which the term 'contextual therapy' applies" (204). To be effective mediators, cynopraxic trainer-counselors must embody, above all, the virtue of fairness. But, in addition to fairness, trainer-counselors should also express clear and frank opinions, display a friendly attitude toward family members, express and show fondness toward the dog, and impress both family and dog with a clarity of purpose. These are key elements of successful cynopraxic counseling.

Cynopraxic counseling and training aim to guide the client and dog into a more satisfying relationship through enhanced affection, cooperation, and trust. This process often emphasizes the need to establish appropriate boundaries and realistic expectations. These boundaries are established and tempered by empathy, mutual understanding, and leadership. A counselor's role as a mediator often entails helping the client to establish appropriate boundaries and to set limits for the dog. Such structuring of interaction results in the dog developing attentional abilities, impulse control, and better organized and effective goal-directed behavior, while it helps the client to form a clearer set of expectations about the dog's behavior and to feel more in control of things. Although training is objectified in terms of controlled behavior and the formation of definite boundaries and limits, the real focus of training is a higher synthesis and resolution, eventually freeing both human and dog to behave spontaneously and freely with each other. The picture is one of mutual harmony, affection, unity, tranquility, and profound respect—what Fox (1979) has called transpersonal relatedness or an appreciation of the dog without contingency or reference to something else beyond the dog. Transpersonal appreciation involves a direct apprehension of the thing itself or what the poet Rilke has called *inseeing* (see Volume 1, Chapter 10: *Mysticism and the Dog*). Framed as such, the adjustment problem, rather than representing a threat to the family's equilibrium, becomes an opportunity for enhanced cooperation and growth for both the family and the dog.

Multidirected Partiality

As mediators, cynopraxic trainer-counselors should show equal concern for family members and the dog. Such so-called *multidirected partiality* (borrowing Nagy's terminology) embodies the all-important ethical principle of fairness. Effective cynopraxic intervention requires that the trainer-counselor acknowledge the client's expectations without losing sight of the dog's needs and limitations. For example, a client's feelings of anger, betrayal, and distrust are valid emotions to have after being bitten by a beloved dog. But an equally valid set of circumstances may have been responsible for the dog's decision to attack, including past learning experiences, adverse or

inadequate socialization, or abusive behavior by the owner toward the dog in the past. The bite incident was not simply a factual event but a socially and psychologically significant transaction between the owner and dog. To assess the situation properly, the counselor must evaluate the incident both as a factual or behavioral event as well as stress its meaning as a transaction between close social affiliates. This process is facilitated by adopting an attitude of fairness toward both the client and the dog, thereby justly acknowledging their respective contributions to the transaction and assigning mutual responsibility for the consequences stemming from it. This attitude of fairness is not intended to justify the dog's behavior or the client's emotional reaction but to recognize that they exist and require *contextualization* (that is, need to be placed into a perspective based on fairness to both parties). The goal of contextualization is to organize the transaction into a more formal and objective problem picture, rendering it more receptive to intervention and change—not engaging in unproductive judgments, criticisms, and behavioral cul-de-sacs.

Coupled with the mediational importance of exercising fairness is analyzing the problem in terms of bidirectional causality. The purpose of counseling is not to assign blame but to develop a program of positive change in the direction of interactive harmony. *Bidirectional causality* means that both the client and the dog are assigned a fair degree of responsibility for the behavior problem. Neither the client nor the dog is blamed for the development of conflict, but both are held accountable for contributing to its resolution; that is, both the client and the dog must change in order to overcome the problem and to attain a more satisfying relationship. As such, the behavioral complaint is interpreted as a symptom and manifestation of an underlying interspecies conflict and failure to achieve interactive harmony, that is, a satisfying relationship.

PSYCHOLOGICAL FACTORS

The majority of dog owners view the dog as an integral extension of the family unit (Levinson, 1969/1997), exerting many subtle and pronounced influences on the family system. These various effects are bidirectional, with the family also exerting powerful influences on the dog's behavior. In addition to accepting the dog as a family member, most people appear to believe that dogs have minds and the ability to think—a perception that has direct bearing on their beliefs regarding how dogs should be treated (Davis and Cheeke, 1998). With the attribution of awareness, thoughts, and feelings, people are more likely to treat dogs humanely and to appreciate their experience empathically. These various attitudes and perceptions about dogs exert a significant influence on the human-dog relationship.

Influence of Owner Attitudes and Attachment

Precisely identifying, describing, and measuring the influence of owner attitudes on dog behavior has been of interest to researchers. For example, Serpell (1996) has reported suggestive evidence indicating that the owner's degree of attachment for a dog has a direct bearing on how satisfied or dissatisfied the person will be with the dog's behavior. A family feeling a strong attachment and affection for a dog tends to be more accepting and tolerant of its behavior. The power of attachment can be quite extraordinary in regards to how behavior is judged. Voith (1984), for instance, recounts an interview with a woman whose baby had been tragically killed by her dog. Surprisingly, she spoke lovingly of the dog and attributed "accidental" causes to the child's death, refusing to blame the dog and hold it accountable for its actions. The grieving woman greatly lamented the loss of the dog and had great difficulty reconciling her affectionate feelings toward the dog with the fact that it had, after all, killed her baby.

Owner Mental States and Behavior Problems

Although the supporting evidence is sparse and contradictory, owner and family attitudes and mental health appear to exercise a significant influence on a dog's behavior. How this occurs remains subject to considerable debate and controversy. Certainly, the manner in

which the owner applies behavior-controlling events (e.g., rewards and punishments) will directly affect a dog's behavior through learning and training. Owners, as the result of mental illness or other causes (e.g., alcoholism), who are unable to interact with a dog in a consistent manner, would naturally exert a disorganizing influence on its behavior. Further, just as attachment levels appear to affect an owner's perception of a dog's behavior, his or her attitude and mental state may also have a direct bearing on the dog's emotional state. Speck (1965), a psychiatrist, reported observing a direct relationship between severe mental illness and a contagion effect on animals living in the same household. In one case report, he described how the agoraphobic symptoms of a mother, father, and schizophrenic daughter were mirrored in a dog and cat that also refused to leave the house. In another report, Speck (1964) noted that, when performing in-home psychiatric counseling with families in which dogs or other companion animals were present, the animals were apt to reflect the family's general attitude toward him. He claims to have learned to predict a friendly, angry, or indifferent session by the way that he was greeted by resident cats and dogs. Further, he reports making a "repeated observation" (152) that in disturbed families the dog may become ill as a result and, if harmony is not restored, may actually die.

These sorts of presumably strong social influences exerted by an owner or family on a dog have not been widely confirmed by practitioners working with problem dogs. Although most counselors and trainers would agree that an owner's attitude or mental state should exert some influence, what the influence might be has not been fully worked out. Some evidence has appeared in the literature in support of such effects, however. For example, O'Farrell (1995) notes that owners suffering from mental disturbances tend to project undesirable qualities and traits onto their dogs more frequently than do owners without such mental problems. Neurotic individuals also tend to report more problematic behavior in their companion dogs. In a relevant study, O'Farrell (1997) was not able to detect a causal relationship between the owners' anxiety levels and the etiology or maintenance of common phobias in dogs (e.g., fear of thunder)—a contagion previously believed to exert a powerful influence on the development of fears (Beaver, 1982). Although not a causal factor, owner anxiety levels do appear to affect how troubling or disturbing the dog's fearful behavior is for the owner. Finally, Dodman and colleagues (1996) performed a small study (N = 10) to assess, among other things, the effects of owner personality traits on the expression and treatment of dominance-related aggression. They did not detect any significant personality-type differences between owners of dominant-aggressive dogs and a control group composed of 10 owners of nonaggressive dogs. The researchers did find, however, that *thinking-type* owners were more likely than *feeling-type* owners to achieve 50% or better improvement in their dogs as the result of implementing a nonconfrontational treatment program.

Triangular Relations

Nearly all families regard their dogs as full members (Cain, 1983; Voith et al., 1992), with some dogs enjoying a privileged status and receiving extraordinary care and affection, whereas others are marginalized and pushed outside of the family's inner circle. Feelings of attachment for the dog often widely differ between family members, with disagreements about the significance or acceptability of the dog's behavior being fairly common. The quality of attachment between family members and the dog may also undergo degradation or disturbance as the result of a behavior problem. Another common source of disturbance involves various patterns of triangulation. Triangles and triangular relations develop in situations where a third party is incorporated into a dyad relationship to deflect intense emotional states (e.g., anxiety and anger) and to secure stability (Papero, 1990). The family dog may be triangulated as an alternative object for feelings of affection, anxiety, or anger arising between family members. As a consequence of such triangular relations, Schurr-Stawasz (1997) suggests that the dog may be variously viewed by family members as a "peacemaker, tension-breaker, or scapegoat" (354). She describes an interesting triangle involving a

dog that became aggressive whenever a teenage boy was yelled at by his mother. Interestingly, however, the dog refrained from barking when the boy initiated the yelling. The boy interpreted the dog's selective aggressive behavior as evidence of its having taken sides with him against the mother.

Triangulated relations may simultaneously enhance attachment and affection levels toward the dog by some family members while reducing these measures of affiliation felt by other members of the family for the dog. In the aforementioned case, the boy might feel closer to the dog when arguing with his mother, while she may feel increasingly irritable and angry at the dog at such times. Fogle (1983) describes an interesting triangle involving a husband, wife, and pet parakeet. Upon returning home from work, the husband would habitually say hello to the parakeet before acknowledging his wife. As a result, the wife gradually developed a "death wish" for the bird:

> Their relationship and attitude to the bird was as clear an indication as any that the marriage was going through a rocky stage (which, incidentally, they were acute enough to observe, strong enough to accept, and willing enough to overcome). The parakeet was a focus for their problems and for a time even made the situation worse. (146)

Given the general effects of attachment levels on a family's perception of the dog's behavior, the disruptive implications of adverse triangles should be apparent and addressed as part of the counseling process. As the result of these and various other considerations, it is of utmost importance that behavioral interventions include the family as a group whenever possible. This is particularly important in the case of interventions involving serious behavior problems, where numerous lifestyle changes and commitments of time might be required of family members. This process can be highly disruptive and frustrating for everyone closely involved with the dog. Consequently, for effective intervention to occur, trainer-counselors must appreciate the influence of family dynamics on a dog's behavior and be sensitive to a family's needs.

Attributional Styles

A potentially valuable approach for understanding the influence of owner attitudes on dog behavior and adjustment problems is provided by analyzing the various ways or *styles* with which the owner interprets his or her influence over significant events [see Davison and Neale (1994)]. As discussed in Volume 1 (see Chapter 9: *Locus of control and Self-efficacy*), attitudes and biases exert a significant influence on learning and personal efficacy beliefs. Believing that control over events is within one's personal ability (*internal* locus) produces significantly different expectancies regarding one's efforts. For example, if one believed that the significant causes of some event were located outside of one's reach and influence (*external* locus), one probably would quickly lose hope and despair of influencing those particular events through personal effort. Attributional styles are not only influenced by locus of control tendencies but are also affected by general attributional characteristics associated with the identified causes, especially their relative generality (*global-specific* continuum) and persistence (*stable-unstable* continuum). Negative global and stable attributions in conjunction with a history of failure in coping with a dog's behavior may cause its owner to experience a high degree of anxiety and helplessness, thereby disrupting his or her ability to address the problem in a constructive or solution-oriented manner.

The extent and duration of a client's frustration or sense of *helplessness* appear to be strongly correlated with the character of internal and external attributions expressed by the client. For example, owners expressing the belief that they lack the necessary emotional qualities (*internal global* attributions) or physical abilities (*internal stable* attributions) needed to control their dog effectively may be expected to harbor a long-term sense of helplessness with regard to their ability to resolve a behavior problem that requires the *internal* attributes that they believe they lack. In addition to promoting a sense of helplessness, negative global or stable internal attributions may also adversely affect an owner's self-esteem, especially if the lacking quality or

ability is perceived as a personal shortcoming. On the other hand, owners who express (or hear) global and stable external attributions, such as biological predispositions (external global attributions) or lasting behavioral deficits resulting from adverse epigenetic events (external stable attributions), may come to believe that their dog's behavior is not likely to change in response to personal efforts, since it is influenced by external causes beyond their control.

To be maximally effective, trainer-counselors must, first of all, help owners to identify faulty or destructive internal or external attributions that block effective intervention. Secondly, counselors should provide owners with more constructive ways with which to interpret and understand the dog's behavior, such as isolating and describing objective causes that can then be addressed through appropriate training and behavior modification. This is especially pertinent in cases involving global and stable internal attributions that compromise an owner's self-esteem.

Enabling and Facilitating

Negative or pessimistic attributional styles appear to express themselves in a variety of dysfunctional ways. Paradoxically, for example, unwanted behavior is often inadvertently perpetuated by owners. Such owners can be divided into two types: *enablers* and *facilitators.* Enablers are distinguished from facilitators by the degree of awareness the enablers possess regarding their contribution to the problem situation. Facilitators are usually much more consciously aware of their active role in the development and perpetuation of the dog's unwanted behavior than are enablers. Further, facilitators are more willing to view the dog's behavior problem in terms of externally objective and controllable factors. Enablers, on the other hand, are often unconscious or unaware of the active role they play in the maintenance of the dog's problem.

Enabling owners are among the most difficult to counsel. They are usually congenial, ostensibly open-minded, and sensitive, but they are often very inhibited with regard to discipline and often lack healthy assertive skills—characteristics that may reflect compromised self-esteem. In matters of professional careers, however, they are frequently very competent in controlling the people with whom they interact in supervisory capacities. I recall a psychologist who worked on a daily basis with violent offenders with great effectiveness as a prison psychotherapist, but who was entirely victimized by her Lhasa apso. It is very difficult to make enabling owners fully aware of their *actual* contribution or to explain how their behavior is impacting on the dog's behavior. They are typically defensive and inclined to place the locus of the dog's problem on the level of some personal shortcoming or failing, underscoring the role of personal self-esteem in such cases. Unfortunately, such internalization may serve to place the problem outside of objective control and change. The distinctive marks of enablers are denial, victimization, and helplessness.

Denial

Denial plays a very important role in such cases; in fact, denial is a distinctive feature of enablers. Habitual denial gives a dog's problem autonomy, placing it outside the reach of rational control. Instead of approaching the problem systematically, an unhealthy atmosphere of shame, resentment, anger, defeat, and hopelessness may begin to hang gloomily over the relationship. These emotions effectively disable an owner and preclude effective action. Denial takes many forms from simply refusing to recognize the existence of the problem to articulating complex pseudoexplanations and rationalizations to account for the dog's behavior. When the misbehavior happens to occur in public, the owner's positive self-image may be threatened or damaged, causing him or her to engage in various "excusing tactics" aimed at making amends for the dog's behavior while at the same time striving to restore their good public image (Sanders, 1999). When discussing their dog's behavior, such clients tend to disclose large amounts of irrelevant information, including detailed explanations, prefaces, justifying accounts, mitigating interpretations, spurious

anthropomorphic causes, and tangential external attributes based on physical ailments or maturity issues. The entire interview may be seeped in a normative language, serving to justify the dog's behavior and making excuses for it, rather than attempting to identify and assess functional causes objectively. Under the influence of denial, the problem is further cultivated and simultaneously pushed out of the reach of effective intervention.

Sabotage

Cynopraxic counselors are not only faced with the very delicate job of objectifying a dog's behavior but also with overcoming a client's active and, more often than not, passive resistance and sense of helplessness. This resistance is not always conscious. In fact, most clients appear very frustrated with themselves for not being able to come to grips with their dog's behavior. Besides lacking the necessary assertive skills needed for effective training and the draining influence of passive resistance, training efforts are often sabotaged. Sabotage takes place on two levels. The dog's behavior problem may serve some dysfunctional purpose within the overall family system; for example, the dog may be triangulated within a family suffering general conflict and disturbance. In some unfortunate situations, the dog may represent the most stable and unifying point of interaction in the family. Occasionally, mental illness or alcoholism exists, and the dog's behavior problems are used by family members as a vehicle to act out or as a weapon directed against each other. Under such conditions, the dog is very likely to fall victim to abuse stemming from unpredictable and alternating mood swings involving affectionate and violent displays.

More often than not, sabotage is the result of enabling and denial. As already noted, enablers are not always aware of their behavior and how it can affect a dog. This is an outcome of the sometimes fanciful and unrealistic picture that clients can paint of dogs. Such owners may maintain and protect this mental escape by behaving in a manner consistent with its underlying presumptions. This state of affairs generally involves substantial emotional and psychological armoring against criticism—armor as amorphous and fluid as shifting sands, yet as hard and impenetrable as stone. In some cases where serious problems develop, instead of giving up the fantasy and emotional satisfaction derived from the myth, such owners simply give up the dog. This situation is reminiscent of Lorenz's (1955) observations with regard to many dog owners whose insensitivity and selfishness are grossly apparent:

> If I question a man who has just been boasting of the prowess and other wonderful properties of one of his dogs, I always ask him whether he has still got the animal. The answer, then, is all too often. . . "No, I had to get rid of him—I moved to another town—or into a smaller house—I got another job and it was awkward for me to keep a dog." (148)

Besides pervasive helplessness, one of the most striking features of enmeshed owners is a pronounced selfishness that weaves itself through the fabric of their relationship with the dog. Selfishness stands out like Pinocchio's nose on a facade of childlike devotion and love toward the dog. It is very interesting to note how much enabling owners complain of the sacrifices they make for their ungrateful canine companions.

Whenever it occurs, denial reflexively results in sabotage. If owners believe that the dog's elimination problem is calculated to make them feel upset or to keep them from going out or to prevent them from inviting a friend to visit, they are not likely to put sufficient effort into proper house-training measures to correct the problem, since they do not really believe that the dog has a house-training problem based on those sorts of causes. If they believe that the dog is compelled by a history of previous abuse to act out aggressively toward guests, they are unlikely to carry out the necessary corrective measures to modify the unwanted behavior. The failure of many training efforts is a direct result of denial and sabotage.

Futurizing

Finally, most people have a strong tendency to procrastinate—to put things off that make them feel uncomfortable. Some people,

though, engage in an *unconscious* form of putting-off behavior that operates in combination with denial and sabotage. This form of denial is referred to as *futurizing*. A common form of futurizing occurs when puppy owners put off training, hoping that the dog will grow out of its misbehavior without their support and guidance. More problematic forms of futurizing occur when owners delay seeking help for a behavior problem and instead allow it to develop into a more unmanageable form, ostensibly believing that it will magically disappear. Futurizing as a form of denial is strongly influenced by collateral anxiety or a fear of failure associated with the process of coming to grips with the problem. Sometimes the issues surrounding the problem may simply be too painful for clients to face, and consequently seeking help is indefinitely put off.

Psychodynamic Factors

The vast majority of clients with problem dogs possess constructive attitudes toward their dog's behavior problem. Occasionally, however, clients will have special needs that require additional understanding and patience. This is a complicated area of counseling that is highly speculative and influenced by psychodynamic concepts that are controversial among behaviorist practitioners. In those relatively rare cases where a dog behavior problem occurs in conjunction with a human psychiatric disorder or substance-abuse problem, counselors are strongly advised to consult with appropriate professionals familiar with such matters.

Dogs are sometimes conceptualized by owners as idealized children or *transitional objects.* Unfortunately, necessary boundaries and reasonable expectations are often suspended when dogs are thought of in such ways. As a result, an owner may lose sight of the dog as a dog, concealed as it is under a projected mask composed of an awkward and ill-balanced concatenation of fantasy and reality. This process of projective idealization incorporates dogs as transitional objects, similar in psychological function to stuffed bears for children. A child treats a stuffed animal as though it were an animated object with feelings and cognitions but realizing all the while that the toy is neither alive nor sentient. In many ways, dogs are sometimes treated as such toys, with the very different and problematic difference that they are both very much alive and sentient:

> That dogs serve as "transitional objects," in a fashion similar to teddy bears, security blankets, and any one of a number of the soft talismen that youngsters carry around to provide comfort when they have been disappointed or are feeling lonely, has been observed by some psychologists and psychiatrists. They do not reconcile that, however, with their equal certainty that dogs represent surrogate children. Although they do not say so, perhaps what they mean is that babying encompasses being babied in that people are giving what they want to get, or that in the minds of infants they and their mother are felt to be one. But there is an important difference between teddy bears and dogs. Dogs are not inanimate but living creatures with whom we have distinctive relationships as much shaped by their species characteristics and individual makeup as by ours. The teddy bear's responses are as we imagine them to be, but Rover's are really those of a dog. (Perin, 1981:81–82)

The result is that many psychological defenses like projection, transference, and splitting may be actively incorporated into the human-dog relationship, which may consequently become progressively fantastical and dysfunctional (Heiman, 1956). The resulting sense of closeness and affiliation may be intensely satisfying for owners, but fraught with many dangers for their dogs. Ensuing magical thought patterns may blur or entirely overshadow an owner's ability to assess and evaluate their dog's behavior objectively (see *Psychoanalysis and the Human-Dog Bond* in Volume 1, Chapter 10).

Such owners may appeal to strange anthropomorphic explanations and justifications for their dog's shortcomings. When problems arise, which they frequently do, the owners often resort to enabling denial and sabotage. They are also inclined to describe their dog's misbehavior in terms of self-centered concerns, especially the emotional pain it causes them. When a dog's behavior falls short of expectations (which are usually very idealized and unrealistic), such owners may feel personally

affronted, deeply let down, often lamenting their attachment and love for the unappreciative dog, and, finally, express painful feelings of victimization and helplessness—the ultimate risks of dysfunctional emotional and psychological exploitation of dogs as attachment objects [see Rynearson (1978)].

SOCIAL PLACEBOS

Some authorities have speculated that a significant factor contributing to the effectiveness of holistic therapy procedures (e.g., homeopathy, acupuncture, and therapeutic massage) results from a special placebo effect or *effect of person* on receptive patients (Rosenthal, 1981). Such therapies share a number of characteristic features. Typically, holistic treatments are rather time intensive, requiring sustained doctor-patient interaction. During treatment sessions, patients are subjected to repeated positive suggestions about the effectiveness of treatment, frequent verbal and nonverbal expressions of care and interest, gentle and reassuring touch during examination, and positive predictions about recovery. The result of such positive interaction and prognostication is an *interpersonal expectancy effect* (IEE) or social placebo. Placebo effects appear to exert a significant impact on the efficacy of medications used to control dog behavior problems (White et al., 1999), perhaps as the result of owner perceptions of the dog's problem, as a result of changes in the interaction between the owner and the dog or both. Some recent research suggests that placebo effects may represent as much as 75% of the beneficial effects of many common antidepressants used to control human depression (Enserink, 1999). Unfortunately, most of the putative benefits of psychotropic drugs used to control dog behavior problems have been obtained as the result of clinical impressions and unblinded studies. Recently, efforts have been made to correct this shortcoming with the appearance of appropriately controlled and blinded studies to assess the *real* effects of these various medications objectively.

Rosenthal (1981) notes that opinions and nonverbally expressed attitudes (self-fulfilling prophecies) have a profound negative or positive effect on health, learning, and therapy. For instance, patients told by an optimistic physician that they are going to recover from a disease as the result of taking some particular medication seem to do better than those told not to expect very much from the medicine. The tendency for such self-fulfilling prophecies to occur have been scientifically evaluated under a variety of controlled conditions. Placebo effects strongly influence experimental results in cases where the study design does not control against experimenter bias. For example, researchers biased by false information about their subjects tend to confirm the expectations in their data, leading to the necessity and use of experimental safeguards like double-blind procedures. Other influences of IEE have also been identified. Teachers misled to believe that certain students possess gifted learning abilities (even though they do not) unconsciously conspire to make the child's scholastic achievement measure up appropriately to those expectations. IEEs are mediated by many interpersonal devices, including indirect ones like tone of voice and body language. For example, children who have been falsely assigned special abilities are often given more opportunities for success and receive more affectionate support for their successes—they are treated as special people and begin to respond as such.

Skillful cynopraxic counselors utilize social placebos and engender positive expectancies in the client-family toward the problem dog. Emphasizing the dog's strong points, placing focus on positive resources, and forming an optimistic perspective on the behavior problem can exercise a very powerful and beneficial influence over the outcome of behavioral training. At the very least, establishing a positive relationship with the client and family will make it more likely that they will accept instructions and carry out training recommendations. On the other hand, a trainer who fails to *join* (borrowing Minuchin's term) the family, or is actively rejected by it as the result of negative interaction or unwelcome criticism, will not likely engender confidence or willing cooperation. Placing the training process on a positive, optimistic level, while applying effective behavioral strategies and maintaining an objective assessment of progress, is an art that cynopraxic counselors must master to be effective.

The Cynopraxic Trainer's Attitude

In addition to embracing scientific knowledge, cynopraxic trainer-counselors acknowledge the value of play, esthetic appreciation, emotional empathy, compassion, and ethical constraint. The cynopraxic trainer's attitude is distinguished by four overlapping characteristics and qualities that mediate connectedness, facilitate the bonding process, and support behavioral healing: composure, sincerity of purpose, presence, and playfulness. *Attitude* refers to a trainer-counselor's mental, emotional, and physical orientation toward the client-owner and the dog. Skilled and effective trainers appear elegant and efficient, cheerful, and gentle, even when setting the most definitive boundaries and limits on a dog's behavior. A cynopraxic trainer's movements are coordinated to *connect* optimally with a dog's behavior in a spirit of harmonious cooperation. Mental and physical composure and consistency make such connectedness possible. Composed trainers show a keen awareness and sensitivity to detail and the ability to focus attention in such a way that training activities possess a quiet presence and precision, without evidence of stifling hesitation, indecision, or doubt. Composure of the *mind and heart* is facilitated by formal and disciplined training activities and humane education in the arts and philosophy. Perhaps the most distinguishing quality of a cynopraxic trainer's character is spontaneity—the cumulative outcome of self-discipline and acquired skills, combined with a beginner's spirit of humility, wonder, and love for dogs.

Sincerity of purpose is closely related and dependent on composure and is the hallmark of a good trainer. *Sincerity* refers to a state of transparent honesty and an ability to express precisely and immediately what is appropriate and fair in response to a dog's behavior. All training interaction with the dog is carried out in a manner that is ever consistent with what the trainer believes necessary to actualize the dog's potential. Josephine Rine (1936) nicely described the value of sincerity of purpose in dog training:

> Look right at the dog as you talk to him, and endeavor to make your tone of voice carry out your meaning no less than your words. The dog is very sensitive to his master's facial expression so be consistent and look pleased or severe as the occasion demands and the spoken words imply. In other words, be sincere with your dog if you would have him retain his confidence in you. Don't expect too much, but on the other hand, don't demand one thing and accept another. (199)

Through sincerity, a direct and reflexive connection is established between what a trainer believes to be in a dog's best interest and what the trainer does. As a result, the trainer becomes a source of consistent, predictable, and controllable interaction, providing a vital foundation for the nurturance of affection, communication, and trust.

Presence is a necessary corollary of composure and sincerity, insofar as a trainer is able to maintain a constructive working relation and *connection* with a dog over time. Dogs live in the moment and, if trainers wish to live and work in close harmony with dogs, they must learn to relate to dogs in terms of a moment-to-moment connection. On a most fundamental level, orientating and concentrating on the present moment is a necessary stance for observing a dog's behavior and properly timing the delivery of training events. All training activities take place in the present tense, and a vital connection between a human and a dog is formed by collecting and focusing on the present. People and dogs connect and bond in the moment, with every simple joy and transformation taking place within the opening and closing of a perpetual threshold between the past and the future. Within the moment, a shared "now" is revealed around which we choose to stay together, cooperate, and live. A dog's experience is in the present moment, with the past and future having little significance, except insofar as they possess meaning for the present.

This present-tense orientation is most effectively organized and mediated through cynopraxic training and play. Training gradually attunes human and dog awareness to the same moment of shared exchange and cooperation or interactive harmony. Remaining true to the moment is most harmoniously achieved through the agency of play. The German

philosopher Friedrich Schiller (1795/1981) observes that play is an essential aspect of our humanity, boldly stating that "Man plays only when he is in a full sense of the word a man, and *he is only wholly a Man when he is playing*" (80). According to Schiller, an artist's ability to make art and our ability to appreciate it as a thing of *beauty* are fully dependent on our play impulse. Similarly, the ability to train dogs is an art that depends on a trainer's ability to play and a dog's ability to play in turn. Where there is no play, there is no relationship or meaning. Play opens the portals of affection and trust between humans and dogs. *Humane* dog training is playing with a purpose, or as Heine Hediger (1955/1968) correctly surmised: "Good training is disciplined play" (139). Cynopraxic trainers embody a playful spirit and value above all else the dog's gift of play.

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Handbook of Applied Dog Behavior and Training, Volume Two: Etiology and Assessment of Behavior Problems is a definitive handbook for dog trainers, behaviorists, breeders, veterinarians, and others who have a serious interest in dog behavior and training. Readers will benefit from the author's twenty-five years of study and experience with dogs as a behavioral consultant and trainer.

The vast majority of dogs exhibit at least one undesirable habit. Most of these problems are responsive to remedial training and brief counseling. However, some behavior problems are the result of a more complex etiology involving adverse emotional influences, cognitive disturbances, or pervasive behavioral disorganization. If not properly identified and treated, such problems may lead to the dog being removed from the home or euthanized.

Volume 2 of *Handbook of Applied Dog Behavior and Training* explores the collective causes underlying the development of serious adjustment problems in dogs. Coupled with Volume 1: *Adaptation and Learning*, Volume 2 provides a comprehensive theoretical and practical framework for understanding the development and treatment of behavior problems.

The focus of Volume 2 is to present and evaluate the relevant applied and scientific literature, with the goals of clarifying what is known about the etiology of dog behavior problems and highlighting what yet remains to be learned. In addition, the author introduces several alternative ways for analyzing and understanding the etiology of behavior problems. Topics covered in depth include:

- History of applied dog behavior
- Behavioral etiology and assessment
- Fear, anxiety, and phobias
- Separation-related problems
- Compulsive behavior problems
- Hyperactivity
- Dominance, territorial, and fear-related aggression
- Appetitive and elimination problems

This volume is an authoritative and thoroughly referenced text that is written in a highly readable and enjoyable style. There are no other applied dog behavior texts of comparable quality and thoroughness available.

Steven R. Lindsay, M.A., is a dog behavior consultant and trainer living in Philadelphia, Pennsylvania. He provides a variety of training and counseling services designed to enhance the human-dog bond and improve dogs' quality of life. In addition to his long career working with companion dogs, Mr. Lindsay previously evaluated and trained highly skilled military working dogs.

ISBN 0-8138-2868-6 90000

9 780813 828688

Iowa State University Press
Ames, IA 50014 • www.isupress.com

Handbook of
APPLIED DOG BEHAVIOR AND TRAINING

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Procedures

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Blackwell
Publishing

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Blackwell Publishing Professional
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Cover image: "Puppies in Snow," by Katsushika Hokusai (1760-1849), Japanese Edo period. Courtesy of the Freer Gallery of Art, Smithsonian Institution, Washington, D.C.

First edition, 2005

The Library of Congress has catalogued Volume One as follows:

Lindsay, Steven R.
Handbook of applied dog behavior and training / Steven R. Lindsay; foreword by Victoria Lea Voith.—1st ed.
p. cm.
Contents: v. 1. Adaption and learning
ISBN 0-8138-0754-9
1. Dogs—Behavior. 2. Dogs—Training. I. Title.

SF433.1.56 1999
636.7'0887—dc21

99-052013

The last digit is the print number: 9 8 7 6 5 4 3 2 1

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Preface

A unifying focus of the *Handbook of Applied Dog Behavior and Training* has been to collect and organize a coherent and integrated body of scientific knowledge with practical and theoretical relevance for understanding and controlling dog behavior—especially problem behavior. The information has been collected from diverse areas of scientific research, including canine evolution and domestication, ethology, behavioral ontogeny, neurobiology, cognition and emotion, and learning. The process of assembling and organizing the information contained in this work bears a resemblance to what E. O. Wilson (1998) has referred to as *consilience*, that is, an inventive linking together of facts and theory from different scientific disciplines to produce a framework of explanation and novel hypotheses. This eclectic process of tying together data-based theoretical accounts and experimental findings from diverse fields not only reveals a significant interdisciplinary order and unity between them, it also produces an astonishing diversity of new ideas and possibilities for taking a fresh look at the organization and disorganization of dog behavior.

The selection of topics covered in Volume 3, *Procedures and Protocols*, has been largely based on criteria of practical relevance and value for dog behavior specialists providing professional behavior therapy, counseling, and training services. Various themes introduced in Volumes 1 and 2 are revisited and expanded upon, especially with regard to significant social, biological, and behavioral influences that impact the etiology of behavior problems and their treatment. Although Volume 3 can stand alone for reference purposes, fully appreciating the finer details and distinctions referred to in the text requires that readers be familiar with the contents of Volumes 1 and 2. There is extensive cross-referencing to these previous volumes, especially when a topic covered requires additional background information or explanation not reviewed in the discussion. Ethological observations, relevant behavioral and neurobiological research, and dog behavior clinical findings are reviewed and critiqued, while various protocols, procedures and techniques are introduced and explained in detail.

Advances in neurobiology, cognitive neuroscience, and psychobiology are revolutionizing our understanding of the neural substrates mediating emotion, cognition, executive functions (attention and impulse control), and learning. In addition to studying normal function and development, brain scientists have accumulated a growing and impressive body of scientific information concerning the organic and stress-related causes of abnormal behavior. Of special interest are experimental efforts under way to tease out and trace the neural substrates mediating expressive emotional behavior and learning. According to a prominent psychobiological theory of emotion postulated by Panksepp (1998), emotional command systems interact in biologically prepared ways to modulate (inhibit or excite) and shape the expression of motivated behavior. Behavioral disturbances may result from adverse learning or traumatic events disrupting the equilibrium of emotional systems—a theory possessing significant practical value for understanding and treating a variety of dog behavior problems. Panksepp's quadrant of emotional command systems nicely dovetails with the primary drives traditionally ascribed to dog behavior. Another exciting area of basic neurobiological research that is relevant for applied dog behaviorists and trainers involves work that is tracing the neural basis of reward. For example, strong data suggest that dopaminergic reward circuits are activated or depressed in accordance with the

occurrence of positive and negative predictions errors—findings that have far-reaching theoretical and practical implications. The neurobehavioral investigation of expectancy, comparator mechanisms, and prediction error is poised to revolutionize our understanding of learning and the significance of reward and punishment. Prediction and control expectancies, calibrated establishing operations, emotional command systems, and the prediction-error hypothesis figure prominently in cynopraxic training theory.

Vulnerability to emotional distress and stress appears to play a significant predisposing role in the etiology of many dog behavior problems. The ability of dogs to cope with stressful situations is influenced significantly by the type and degree of stress that they are exposed to in early development. Although some limited exposure to stress is beneficial, inappropriate stress and traumatic fear conditioning may produce a lasting adverse effect on the way dogs cope with stressful situations in adulthood. The organization and functional integrity of the brain are strongly influenced by prenatal and early postnatal stress, perhaps predisposing dogs to develop a variety of stress-related behavior problems and disorders. A very active and productive area of brain research has been dedicated to exploring the effects of adverse postnatal stress on the developing brain and behavior. Some of this research has been reviewed in the context of potential factors that predispose affected dogs to develop aggression and separation-related problems. In addition, brain scientists are closing in on the genes, receptors, circuits, and complex matrix of biochemical pathways mediating the learning and expression of emotional behaviors. This research suggests that highly effective and precisely targeted medications might be available in the not-too-distant future for controlling fear-related problems and aggression that currently remain refractory to conventional treatment. Finally, neurobiology has considerable value for identifying putative organic causes of behavioral disorder and the probable mechanisms mediating pharmacological benefits, which is information of considerable value to veterinarians requiring coherent rationales for prescribing psychotropic medications to manage behavior problems. Knowledge of neurobiology and behavioral pharmacology offers nonmedical behavior modifiers insight into the close link between brain function, emotion, and behavior, and provides an improved appreciation of the use of drug therapy in the treatment of behavior problems.

What a dog does, its propensity to learn, the range of what it learns, and the way it goes about learning it are preemptively influenced by biological constraints. These phylogenetic predispositions include both evolutionary adaptations of an ancient origin as well as more recent changes wrought by domestication and selective breeding. Although heredity exerts a powerful effect, the social and physical environment plays a decisive role in the way these biological propensities are expressed in a dog's behavioral phenotype. From conception to senescence, biobehavioral ontogeny is in a continuous process of change and adaptation, with each stage in a dog's development affecting subsequent phenotypic physical and behavioral characteristics and organization (epigenesis). Whereas normal and protective environments nurture adaptive behavior, abnormal and distressing environments facilitate the elaboration of various emotional and behavioral disturbances increasing a dog's vulnerability to serious adjustment problems. In addition to the disturbing effects of adverse early experiences (e.g., prenatal and neonatal stress, early abuse and trauma, and social deprivation), a wide range of disorganizing emotional and behavioral effects are mediated by stressful or neurotogenic environments possessing insufficient order and regularity to promote social competence and adaptive success.

Environmental pressures shape both phylogenetic and ontogenetic adaptations. Dogs are compelled by an ever-present array of internal and external environmental pressures to adjust in various ways. In addition to an assortment of relatively rigid adjustment mechanisms (e.g., reflexes and modal action patterns), dogs are biologically equipped to adjust to environmental pressures by means of behavioral changes organized by learning. Dogs possess sophisticated cognitive, instrumental,

and associative learning abilities that enable them to cope with and adapt to complex and variable environmental circumstances. These abilities enable dogs to find and exploit necessary resources (comfort seeking) and to detect, escape, or avoid environmental hazards in the process of doing so (safety seeking). Competent instrumental control over significant aversive and attractive events is only possible to the extent that a dog is able to anticipate and prepare for their occurrence in advance, which requires that the environment possess a certain degree of regularity and constancy with respect to such events and that the dog possess the ability to codify the benefits of experience into a useful and accessible form. The predictive information needed is obtained by means of classical conditioning, whereby contexts and incidental stimuli that regularly anticipate significant events are associatively linked, thereby preparing the dog emotionally and behaviorally to respond effectively. Learning of this sort provides a major organizing or disorganizing influence via the formation of prediction expectancies and preparatory appetitive and emotional establishing operations. Behavior operating under excessively disordered circumstances tends to produce varying levels of conflict and stress (anxiety and frustration), attentional strain and disturbance, impulse-control deficits, insecurity, emotional reactivity and panic, and behavioral incompetence—sequelae often associated with common dog behavior problems.

Just as evolution depends on an organism's capacity to maintain stability while changing, the optimization of prediction-control efforts depends on a balance between necessity and uncertainty. Whereas evolutionary advances are the results of life and death experiments etched into a species' genome and transmitted by genetically related individuals to progeny, behavioral adaptation proceeds in accord with interactive experiments consisting of social exchanges and transactions that transmit a collective culture, whereby culturally related individuals and their progeny are able to coexist in relative harmony and security (comfort and safety). Although the attainment of enhanced prediction and control over environmental events is a significant adaptive priority of organized behavior, learning does not proceed by the confirmation of prediction and control expectancies alone, but depends on adjustments resulting from the detection of prediction errors. Logically speaking, well-predicted and well-controlled events routinely produced by the dog do not require that it learn anything else about them beyond what it already knows, at least so long as the situation remains the same. The occurrence of such anticipated outcomes may elicit strong emotions conducive to comfort and safety (e.g., gratification and relaxation) that may incidentally excite or inhibit behavioral output, but it does not produce reward or punishment unless the anticipated outcome is found to be better or less aversive than expected. Adaptive learning depends on environmental conditions that provide enough order to foster reliable predictions together with sufficient change and variety to produce prediction dissonance. Either extreme of excessive regimentation or disorder (confusion) is inimical to instrumental learning. Consequently, given the deleterious effects of either extreme order or disorder, behavior therapy and training activities should be designed to strike a balance between the dog's need for order and its need for variability.

Chapter 1 provides a foundation of procedures and techniques used for basic training and the prevention or management of a variety of behavior problems. Basic training is an important aspect of cynopraxic therapy, playing a significant role in the treatment of virtually all behavior problems by improving interactive dynamics and establishing a platform of training and conditioning that complements and facilitates the implementation of behavior-therapy procedures. Emphasis is placed on the importance of integrating training activities into the home and bringing the dog under the control of everyday rewards and play—a process referred to as *integrated compliance training* (ICT). Although food reinforcement figures prominently in many cynopraxic training and therapy procedures, strong emphasis is placed on the pivotal role of affection and play for mediating behavior change via a normalization of human-dog interaction.

Play is particularly valued for its capacity to mediate cognitive and emotional transactions conducive to fairness, mutual appreciation, and interactive harmony. In addition to providing means for integrating and elaborating complex patterns of motivated behavior, play mediates powerful therapeutic effects by balancing emotional command systems, enhancing the human-dog bond, and improving the dog's quality of life. In general, attractive motivational incentives are used to facilitate a perception of control over significant events and enhanced power (competence and confidence).

Cynopraxic training efforts are distinguished by a focus on attentional functions (attending and orienting behavior), expectancies, and emotional establishing operations. Creating a framework of mutual attention and focus between the trainer and the dog is critical for communication, emotional transactions, and the bonding process. Attention control plays an important role in most dog behavior therapy and training procedures insofar as it mediates improved impulse control, social engagement, and autonomic attunement. Focusing training efforts on attending and orienting behavior is extremely efficient for establishing control over highly motivated behavior, especially when it is combined with the activation of potent conditioned and unconditioned appetitive and emotional establishing operations. For attention control to be maximally effective, it requires timeliness, ideally linking orienting stimuli, conditioned reinforcement, and establishing operations with the earliest intentional movements in anticipation of action, the target arc. Intensive orienting and target-arc training with positive prediction error exert a number of far-reaching benefits in the context of cynopraxic behavior therapy, virtually rebooting attentional functions, invigorating the social engagement system, and modifying preattentive biases. Rather than attempting to establish direct control over highly motivated and complex behavior by head-on means, many behavioral efforts are facilitated by first training a dog to orient toward the trainer, to attend (make sustained eye contact) in response to its name, and to pursue deictic signals or commands directing the dog's attention by gesture and gaze, and then building a small repertoire of reliable basic-training modules and routines (e.g., come, sit, down, stay, and controlled walking) via reward-based efforts incorporating both attractive and aversive motivational incentives. By means of basic training, attention control is progressively integrated with behavioral adjustments incompatible with undesirable activities and gradually unlinks attentional connections with competing sources of gratification and reward (distractions).

Chapter 2 contains foundation procedures and techniques for the control of inappropriate elimination, appetitive and ingestive behavior problems, and destructive exploratory activities. These basic areas of adjustment can exert a profound and enduring adverse effect on the bond and the dog's quality of life. Dog's that habitually eliminate in the house or destroy personal belongings may foster a high degree of familial resentment, often leading to excessive confinement, abusive punishment, or relinquishment. The section on house training completes a discussion on elimination problems begun in Volume 2, where several procedures and techniques used for controlling common elimination problems are discussed. In addition to methods used for controlling destructive behavior, various techniques are explored for the management and treatment of pica and coprophagy. The eating of nondigestible items is a significant health concern because it may result in life-threatening intestinal obstructions. Coprophagy also represents a health risk, but the greatest risk of harm is the damage such behavior does to the human-dog bond. Since coprophagy is highly offensive to the average dog owner's sensibilities, the disgust for the habit is easily transferred to the dog, especially in cases where small children affectionately interact with the dog. As a result, excessive or persistent coprophagy should receive prompt medical and behavioral attention aimed at resolving it, rather than be brushed off as an innocuous canine vice.

Chapter 3 explores the functional and dysfunctional significance of fear together with a variety of techniques and procedures used to

treat fear-related behavior problems. Maladaptive fear and anxiety figure prominently in the etiology of many adjustment problems as well as serious behavior problems. Once established, certain fear reactions may become virtually permanent, forming highly durable and extinction-resistant associations with conditioned eliciting stimuli. Dogs exhibiting such phobias are often treated with procedures aimed at reducing fearful arousal while exposure is organized in a way that encourages more effective coping strategies when faced with fear-eliciting situations. These procedures usually involve some form of graded interactive exposure or desensitization process carried out in combination with counterconditioning. Many fearful behavior patterns appear to operate under the influence of faulty prediction and control expectancies. Avoidance behavior occurring in association with fearful arousal may prevent a dog from discovering that its fear is unfounded, simply because the dog does not remain in the situation to recognize that it is not dangerous and that the anticipated aversive outcome does not occur. In essence, since the expected outcome never occurs, the avoidance response confirms the control expectancy. Consequently, response-prevention procedures are often used to block avoidance behavior with the goal of demonstrating to the dog that the aversive contingency no longer exists, thereby gradually extinguishing the avoidance response. Graduated exposure and response prevention are usually performed in conjunction with fear-antagonizing counterconditioning efforts and instrumental training efforts aimed at shaping behavior and expectancies incompatible with avoidance and fear. In addition to dysfunctional or faulty prediction and control expectancies, many common canine fears appear to stem from competency doubts arising in potentially dangerous or risky situations. Counterconditioning techniques are of little value in treating fears maintained under the anxiety and pessimism of competency doubts. In such cases, fear is treated by means of graded interactive exposure in combination with the progressive development of various skills needed to successfully control the feared situation (e.g., climbing stairs). Along with developing competent skills, the dog naturally becomes more confident and relaxed—a potent counterconditioning effect that follows from training and systematic skill development. In addition to social fears and avoidance, many aggression problems appear to stem from competency deficits, whereby the dog enters into provocative exchanges under an expectation of failure. Cynopraxic training enables dogs to cope more effectively with fear through the empowerment resulting from reward-based training. Learning to control the occurrence of attractive and aversive motivational stimuli promotes an improved sense of power that enables dogs to approach situations perceived as threats or challenges with a positive expectancy bias.

Chapter 4 addresses problems that occur in association with emotional agitation and distress at separation. The term *separation distress* has been chosen over the more commonly used term *separation anxiety* because the former term seems to capture more accurately the diversity of the emotional causes and varied presenting signs that characterize this collection of behavior problems. Although dogs distressed at separation often exhibit anxiety and worry, they also exhibit signs of frustration and panic, which are coactive states of arousal that likely arise from different causes and that may accordingly require different strategies of control and management. The term *separation distress* seems preferable to *separation anxiety* because the former is sufficiently general to encompass a varied group of coactive emotional influences, while remaining consistent with the experimental use of the term, denoting the propensity of young animals to become agitated or depressed when separated from maternal and sibling attachment objects or others with whom a state of reciprocal autonomic regulation or attunement has been established through interactive exchange. Also, separation distress appears to originate in a circuit dedicated to the generation of a special type of aversive emotional arousal associated with social loss, which is emotional activity that is sensitive to a variety of coactive excitatory and inhibitory influences, including anger, frustra-

tion, anxiety, and fear. Adopting the term separation distress also helps to distance separation reactivity in dogs from potentially misleading connotations and implications derived from the use of the term separation anxiety in child psychiatry.

Currently, the most common procedures used to control problematic separation distress are systematic desensitization and detachment training. These procedures are discussed in detail. Both procedures are hampered by compliance problems, on the one hand, due to technical and practical difficulties associated with the implementation of systematic desensitization and, on the other hand, stemming from the unwillingness of many dog owners to consistently impose restrictions on their dog's affection- and contact-seeking behavior. Various protocols emphasizing the importance of secure place and social attachments in the treatment of problematic separation distress are presented. Instead of breaking down the attachment between the owner and the dog or exclusively relying on techniques to reduce anxiety or other coactive symptoms presenting at separation, emphasis is placed on training and therapy procedures that improve the quality of the existing attachment and bond. Essentially, the goal of such training is replace dependent and insecure or nervous attachment dynamics and reactive patterns of separation behavior with a more mature and trusting bond while systematically shaping a more competent repertoire of separation behaviors. These objectives are achieved by means of various behavior therapy procedures, including the implementation of a program of variable and reward-dense separation exposures (planned departures), with the goal of organizing more secure separation expectancies and enabling the dog to endure stressful separations without becoming overly reactive or panicked. Training activities that increase social trust and secure attachments (comfort and safety) are central to the effective treatment of separation-related problems.

An increased vulnerability to separation distress (and aggression) may be causally related to stressful insults occurring at a formative stage of development. To evaluate possible causal linkages between prenatal and postnatal stress on developing behavior, relevant lines of neurobiological research are reviewed, which is a theme that is continued in the context of aggression problems in Chapter 8. Interestingly, separation-distress problems often share with serious aggression problems an element of panic (reactive incompetence) arising in association with social exchanges and transactions that threaten a loss of comfort or safety. Both sets of adjustment problems present with a similar autoprotective urgency, but, of course, operating under diametrically opposed incentives aimed at producing quite opposite effects, yet sharing equally reactive and incompetent means, namely, efforts to increase proximity (separation distress) versus efforts to decrease proximity and contact (intrafamilial threats and attacks). Separation distress and intrafamilial aggression appear to share a common hub of vulnerability and autonomic dysregulation that develops in the process of forming regulative attachments with people, making such problems and their treatment preeminently cynopraxic in nature, and underscoring the necessity of therapy and training activities to reduce social ambivalence and entrapment tensions, promote comfort, safety, and power (security), and secure place and social attachments. Although genetic and stress-related neurobiological factors probably play a predisposing role in the development of many separation-distress and aggression problems, giving owners appropriate counseling and providing at-risk puppies with supplemental training may substantially help to ameliorate or prevent some of these problems. Initiating protective and counteractive measures at an early stage in the epigenetic process is more likely to succeed than belated heroic efforts performed after the problem behavior is well established. Of particular importance in this regard is the provision of secure environmental circumstances, the development of a trusting bond, and training efforts to help the puppy or dog learn how to cope more competently with the periodic loss of comfort or safety resulting from social separation.

Chapter 5 deals with various procedures and protocols used for controlling and managing excessive behavior. Compulsive excesses

are under the control of a variety of evoking and exacerbating influences, many of which remain obscure. Dogs prone to motor compulsions are often highly active and intolerant of frustration (choleric or c-type dogs), whereas dogs showing self-directed compulsions (e.g., licking) may be particularly vulnerable to the adverse effects of anxiety and depression (melancholic or m-type dogs). One theory suggests that compulsive actions may trigger reward circuits that help to maintain the activity in the absence of other sources of extrinsic reward, perhaps reflecting a failure of the dog to obtain adequate reward in more adaptive ways. Control and management programs frequently include efforts to remove or minimize adverse sources of social (interactive conflict and tension) and environmental stress, consisting of significant events perceived as uncontrollable, while introducing training activities designed to normalize executive cognitive functions (attention and impulse control). Play therapy is often employed to balance emotional command systems, provide a source of reward and gratifying interaction with the owner, and increase object interest and environmental exploratory activities. Finally, a variety of behavior-therapy and training procedures are described for the treatment of specific compulsive behaviors, including diverting or disrupting techniques, counterconditioning, shaping incompatible behaviors, bringing the compulsive behavior under stimulus control, exposure with response prevention and blocking, and, in the case of refractory or physically harmful compulsions, inhibitory techniques.

Impairments associated with compulsivity and hyperactivity appear to represent the opposite ends of a common continuum or spectrum related by functional significance. Whereas compulsive dogs tend toward introversion, repetitive self-directed activities, and intolerance for anxiety and danger, hyperactive dogs are typically extraverted, tend toward highly variable and other-directed activities, exhibit a high degree of fearless (bold) behavior, and show intolerance for frustration and a propensity toward impulsive aggression. Whereas compulsive dogs have trouble controlling autodirected activities, hyperactive dogs exhibit difficulty controlling allodirected activities, exhibiting executive disturbances affecting their ability to regulate ongoing activity voluntarily. These correspond to passive and active modal activities launched to cope with drive-activating stimulation but disengaged from competent prediction-control expectancies, giving compulsive behavior and obsessional appearance. The compulsive-impulsive continuum may represent a significant temperament dimension that has been differentially selected and preserved during the dog's evolution. Depending on environmental conditions, the traits of compulsivity or impulsivity may be variably adaptive or maladaptive with respect to survival. Traits associated with hyperactivity and impulsive behavior may be conducive to survival under conditions of adversity and scarcity, whereas compulsive traits may be more adaptive and useful under conditions of plenty, suggesting the possibility that phylogenetic survival modes and quality-of-life factors may play a significant role in the expression of such traits (see *Phylogenetic Survival Modes* in Chapter 10).

The executive attention and impulse-control deficiencies associated with hyperactivity are improved by reward-based integrated compliance training aimed at shaping improved attending and waiting behaviors. Explicit training of attention skills appears to focus and invigorate impaired executive impulse-control functions. As a result of the hyperactive dog's preference for novelty and surprising events, attention training makes use of prediction dissonance (i.e., varying the size, type, and frequency of attractive outcomes) to build attention and impulse control. Without gaining conditioned control over attention, there is little possibility for effectively and consistently interrupting highly motivated activities, activating antagonistic appetitive or emotional establishing operations, or prompting incompatible instrumental behavior. In addition to attention therapy, time-out, response blocking, overcorrection, and posture-facilitated relaxation training are employed to help discourage behavioral excesses. Perhaps the most valuable strategy for controlling and managing hyperactivity

and associated problems is to integrate attention and impulse-control training into the context of play.

Chapters 6, 7, and 8 are dedicated to exploring the etiology, safe management, and treatment of a broad spectrum of common aggression problems. Aggression problems are distinguished by a significant factor of risk and danger to the cynopraxic therapist/trainer, the client family, and the public at large. Calculating and managing these risks in an informed and professional manner is an important aspect of interventions involving aggressive dogs, particularly involving dogs with a history of delivering hard and damaging bites. Assessment, decisions on whether to accept cases, articulation of working hypotheses, selection of a course of therapy and training, evaluation of the benefits of training, and prognostic opinions require that the cynopraxic therapist possess a significant amount of technical knowledge and direct experience handling aggressive dogs. In addition to bringing competence to the situation, the cynopraxic therapist/trainer must be able to convey a realistic picture of the risks involved and the likely benefit of training. The owner needs to be made aware that the control and management of aggression problems is an art that is prone to many uncertainties and vagaries with respect to outcomes, but may nonetheless help to improve the dog's behavior and reduce the risk of aggression by instituting appropriate and effective precautions, reducing interactive conflicts and tensions, increasing the occurrence of prosocial behavior, and improving the dog's confidence and ability to relax. Nevertheless, the risk cannot be entirely eliminated, and the dog might bite at some point in the future, despite the most conscientious efforts. On principle, serious aggression problems cannot be cured but many can be successfully controlled by means of preventive and preemptive management, behavior therapy, and training. This limited prognosis is a far cry from what most owners want to hear about the fate of their aggressive dog, but it is something that needs to be driven home with no waffling or exceptions—there will always be some risk for a similar or worse bite in the future. To be successful requires of the family a lifelong commitment to preemptive management and training. In accordance with the dead-dog rule (training objectives should not be guided by assessment markers that a dead dog can satisfy), successful training and therapy are not measured merely by the absence of an aggressive episode for some period (dead dogs do not bite), but more significantly success is measured by an increase in socially competent, cooperative, and friendly behavior in situations that previously provoked reactive incompetence and aggression.

The dog's dependency on human prerogative and fickleness for obtaining its survival needs places significant pressure on it to learn how to anticipate and control human contingencies of reward and punishment. As a result, social interaction that lacks adequate predictability and controllability may produce significant conflict, stress (anxiety and frustration), and social ambivalence, potentially exerting a persistent deleterious effect on the dog's ability to organize competent social behavior and trusting expectancies regarding social change. The dog cannot simply leave a disorganized and emotionally destructive situation but is forced to cope and adjust to it (entrapment). Unable to leave the relationship and pressed to the limits of its ability to cope with its vagaries and inconsistencies, the predisposed dog may become progressively agitated, irritable, intolerant, emotionally rigid, and reactively incompetent. Consequently, the process of cynopraxic counseling and therapy is guided by a principle of fairness in which both the family's expectations and the dog's needs and limitations are acknowledged and given appropriate weight and consideration when resolving interactive conflicts and tensions that interfere with the development of a trusting bond. Finally, quality-of-life issues need to be carefully assessed and addressed, insofar as they adversely affect the dog's ability to develop a secure place and social attachments as well as predispose it to increased irritability and emotional reactivity. Dogs that are sick, in pain, improperly fed, inadequately exercised, denied play and variegated forms of environmental stimulation, excessively confined or isolated, and so forth may show signs

of increasing irritability and progressive autoprotective insularity and reactive intolerance toward social interference and contact.

How dogs cope with social ambivalence and entrapment dynamics depends on a variety of predisposing factors, including heredity, prenatal and postnatal stress, and the quality of early socialization and training activities. In addition to impairing cognitive functions, excessive emotional stress, inadequate or inappropriate socialization, and abusive-traumatic handling may focalize persistent disturbances in vulnerable emotional command systems (anger/rage system). Potentially serious emotional disturbances of this kind may be produced by abusive social transactions involving the simultaneous elicitation of high levels of fear and anger. In extreme cases, a history of abusive handling may impair a dog's ability to modulate aggressive arousal in response to even mildly provocative stimulation. Under such circumstances, fear or anger may spark a spiraling and rapidly escalating state of emotional reactivity (panic), thereby setting the stage for an reactive attack arising from a dog's incompetent attempt to cope. In moderate cases, abusive transactions may predispose a dog to conflict-related stress (anxiety and frustration) associated with close social contact. Consequently, the dog may exhibit an increased sensitivity to anxiety or frustration occurring in association with minor intrusions and losses of comfort (frustration) or risks to safety (anxiety), thereby intensifying autoprotective behavior and increasing the dog's readiness to threaten or bite. In all cases, a dog's ability to form a trusting bond with humans is significantly harmed by abusive and traumatic handling. The extent of harm and the type of emotional disturbance that such handling produces depends on a dog's temperament, the severity of the emotionally destructive transaction, and the presence or absence of reconciliation efforts and ameliorating influences (e.g., supplemental socialization and training).

A failure to establish or to maintain a trusting bond appears to play a prominent role in the development or exacerbation of many domestic aggression problems. The rehabilitation of an aggressive dog is not so much about imposing a structure of dominant and subordinate roles (although the necessity of setting appropriate limits should not be neglected) as it is concerned with the restoration of interactive order and harmony by means of affectionate, appetitive, and playful interactions, with the goal of increasing interactive cooperation, familiarity, and trust between the owner and the dog. The comfort and safety associated with orderly and nurturing interaction serve to increase a dog's enjoyment of social contact as well as to improve its tolerance for intrusive interaction. In addition to facilitating fairness and friendliness, play appears to enable dogs to cope with social uncertainty in a more positive way. In general, the dog that has formed trusting expectancies toward the owner is more likely to exhibit tolerance and restraint when exposed to provocative stimulation than is the dog that is uncertain or socialized to distrust the owner. Dogs that have formed a trusting bond appear to give the owner (and others) the benefit of doubt when faced with uncertain situations rather than interpreting provocative or unexpected transactions in worst-case terms and jumping to threatening or retaliatory conclusions. In the absence of a flexible and trusting bond, human-dog interaction is prone to degenerate, resulting in varying degrees of persistent uncertainty and suspicion, anger and irritability, distrust, and reactive incompetence. These sorts of social expectancies and emotional establishing operations combine to lower reactive thresholds and increase the likelihood that the dog might threaten or attack in response to innocuous social intrusions. Identifying puppies that show reactive tendencies at an early age or exhibit other indicators of increased risk (low fear and anger thresholds) and providing puppy owners with counseling on proper training and management may protect against the development of more serious aggression problems later.

In recent years, there has been a growing professional use and interest in electronic devices for dog-training and behavior-modification purposes. Unfortunately, scant little technical information has been written on the proper use of such devices in the context of

canine behavior therapy and dog training—a situation that is especially problematic with respect to radio-controlled collars. With significant trepidation and concern about the potential for abuse, Chapter 9 addresses the use of electronic devices in the context of problem solving and training. When properly used, such devices and techniques can be highly effective and humane for the control of certain otherwise intractable or difficult-to-control behavior problems. It is the author's sincere hope that cynopraxic trainers will use electronic devices, and other tools that produce aversive stimulation and startle, sparingly and with an appropriate degree of restraint and respect for the dog and not fall into the trap of reaching for an electronic collar whenever a tough problem presents itself. Aversive tools and techniques can be extremely useful as motivational incentives to promote behavioral change in the context of reward-based training efforts, but they should not become an alternative to affectionate, playful, and creative attractive incentives. Aversive procedures should be applied in conformity with the dead-dog rule (see *Dead-dog Rule* in Volume 2, Chapter 2), the least intrusive and minimally aversive (LIMA) principle, and cynopraxic goals.

As a philosophy and method for investigating natural phenomena, science is generally a powerful and productive way for acquiring, organizing, and putting knowledge to work. Scientifically informed and coherent procedures and protocols are more likely to work and survive the test of time by virtue of their explanatory value, efficacy (combining simplicity, efficiency, and effectiveness), and adaptability, that is, their ability to continuously adjust and improve in accord with scientific progress. However, despite the obvious value of the scientific method for obtaining descriptive and causal information, the scientific method suffers from a lack of serious regard and sensitivity for some of the more subjective and emotional aspects of human-dog interaction. Interactive exchanges (particularly problem behavior) are not simply factual events but emotional transactions with various levels of meaning and significance that will forever slip through the Cartesian grid. In addition to practical criteria of success, canine behavior-therapy and training procedures must be applicable to the domestic situation, offer benefits for both the human-dog bond and the dog's quality of life, and be humane. As a result of these special requirements, scientific means are tempered and given humane direction by confining their use to the pursuit of cynopraxic goals and vision.

In writing this series, the author has directed a significant amount of attention toward developing a theory compatible with scientific and cynopraxic interests in order to establish a firm but flexible foundation for the advancement of canine behavior counseling therapy and training. Chapter 10 draws together the central elements of cynopraxic bonding, training, and biobehavioral theory. These theoretical concepts and principles have been discussed and elaborated to various degrees throughout the *Handbook of Applied Dog Behavior and Training*, and readers should refer to relevant sections in Volumes 1 and 2 for additional discussion regarding cynopraxic bonding theory, philosophy, and ethics. The goals of cynopraxic theory are to clarify cynopraxic processes, to develop an account of learning that is compatible with cynopraxic objectives, and to establish a simplified and coherent language for describing organizational learning processes associated with cynopraxic training and therapy. Cynopraxic theory incorporates a pragmatic principle of fallibility, acknowledging the possibility of error in its inferences and explanations, thereby embracing a readiness to adjust in accordance with future scientific progress; however, the dyadic goals of cynopraxic training and therapy are considered indisputable, namely, enhancing the human-dog bond while improving the dog's quality of life. The study of cynopraxic bonding, training theory, and practice arts is referred to as *cynopraxiology*.

No compendium of instructions can take the place of competent professional help for properly assessing canine behavior problems and prescribing behavior-therapy and training recommendations. The assessment procedures, instructions, guidelines, recommended devices and uses, behavior-therapy protocols,

and training techniques described in Volume 3 assume that the user is appropriately experienced, knowledgeable, skilled, and qualified to apply them in a selective, competent, and safe manner. The proper selection and implementation of behavior-therapy and training procedures require that the behavior practitioner possess a thorough appreciation of their therapeutic benefits, risks, and potential adverse side effects. Aggression problems are particularly risky and problematic and should only be treated under the supervision of a competent professional qualified to give such advice and instruction. Improperly treated aggression problems may rapidly worsen, becoming more dangerous and difficult to manage or control. While Volume 3 offers educational information that may be of significant value to dog owners and others interested in dog behavior, it is not intended as an alternative to professional cynopraxic counseling and supervised treatment activities.

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Acknowledgments

Writing a book is the culmination of many influences and the help of many people. I have enjoyed the encouragement and support of numerous individuals who have given me valuable advice and inspiration, engaged me in useful discussion, or have simply been helpful in tracking down information or other small matters and details. Listing and individually thanking all of these wonderful people would be impossible and not without the risk of overlooking someone in the process. So, instead of thanking some of you, I hope that it suffices to thank all of you for your unselfish help. I also thank the clients who have entrusted me with the responsibility of helping them work through behavior problems with their dogs. The concept of cynopraxis and many of the procedures and protocols described in Volume 3 could not have been developed without their confidence and participation. A special thank you is due to Christina Cole for her many sacrifices on by behalf and her steadfast support of the project from its inception to completion.

Handbook of Applied Dog Behavior and Training

Volume Three

Procedures and Protocols

1

Cynopraxic Training: Basic Procedures and Techniques

PART 1: FOUNDATIONS AND THEORY

BENEFITS OF CYNOPRAXIC TRAINING

A coevolutionary process of mutual exchange and adjustment appears to have prepared a biological bond between people and dogs making them compatible to live together in the home (see *Coevolution, Play, Communication, and Aggression* in Chapter 6). The training process helps to perfect and intensify this evolutionary bond while enhancing our mutual appreciation of one another. In addition to enhancing the ability of people and dogs to relate, training serves the obligatory role of improving the quality of canine life under the constraints of domesticity. Learning to come reliably when called or to walk on leash without pulling, along with sundry other useful and critical behaviors, provides an effective and safe means to liberate dogs from the drudgery of excessive confinement and an overly narrow social and environmental life experience. In effect, no activity offers more potential benefit for enhancing the human-dog bond and improving the dog's quality of life than training (see *Cynopraxis: Training and the Human-Dog Relationship* in Volume 1, Chapter 10).

The dog's close social interaction with people requires that it learn to accept certain inevitable limits and boundaries, respond reliably to a number of basic commands, and exhibit habits and manners conducive to domestic harmony. These general behavioral objectives are integrated into everyday training activities, thereby strengthening the social connection between the owner and dog as well as facilitating interactive harmony and the development of cooperative behavior. Learning to defer and comply with owner directives is essential for a dog to become a successful companion. A dog's proper adaptation to life with people demands responsible discipline and the establishment of appropriate limits and boundaries. Without boundaries and social distance, a relationship is not possible. Whereas assertions of dominance serve to establish social distance and set limits upon the expression of unacceptable behaviors, leadership promotes more acceptable and cooperative behavior by means of affectionate encouragement, play, food giving, and other nurturing activities. Deference to limit-setting actions and assertions of control promotes affectionate and voluntary cooperation, thereby providing the necessary preconditions for effective leadership. Training helps dogs to learn that deferring and following the owner's lead optimizes their ability to obtain comfort and safety. By learning to follow rules happily and obediently, social conflicts are reduced and a leader-follower bond based on affection, communication, and trust is allowed to

TABLE. 1.1. Benefits of cynopraxic training

Provides a foundation of communication based on predictable and controllable exchanges between the owner and the dog
Provides the owner with effective management and control skills
Systematically balances the triune bond consisting of dominance, leadership, and nurturance
Improves the dog's attention and impulse-control abilities
Promotes affection and mutual appreciation
Establishes habits conducive to domestic harmony
Enhances social adjustment, cooperation, and competence
Promotes relaxation and a sense of well-being
Builds confidence and trust

form—an essential foundation for the development of a healthy human-dog relationship (Table 1.1).

Training promotes behavioral change by manipulating contingencies of reinforcement and punishment. For dogs, social and environmental predictability and controllability are necessary preconditions for security, contentment, and well-being. A failure to predict and control significant attractive and aversive events adequately gives rise to varying degrees of disstress in the form of anxiety and frustration. Of course, when present in limited amounts, anxiety and frustration are conducive to enhanced adaptive success (e.g., prediction error), but in situations where excessive and persistent social conflict and interactive tensions are present, a dog's ability to function in an organized way may gradually deteriorate or break down (see *Experimental Neurosis* in Volume 1, Chapter 9). Dogs living under stressful and inescapable conditions of social disorder and adversity are vulnerable to develop a wide range of behavioral adjustment problems and disturbances (see *Dysfunctional Social and Environmental Influences* in Volume 2, Chapter 2).

Interactive conflict and tension between the owner and dog often develop in the context of antagonistic control interests. In many daily situations, the owner stands between the dog and the acquisition of a variety of highly valued rewards or prevents the dog from escaping or avoiding aversive events, often occurring as the result of engaging in rewarding activities forbidden by the owner. Dog owners often dedicate a tremendous amount of energy to regulate the appetitive interests of their dogs by employing a variety of active and passive control strategies, primarily involving interactive punishment and confinement. Active punitive strategies are particularly problematic since they are often used without much, if any, subsequent concern for showing the dog how to obtain the gratification that it is seeking while engaged in the forbidden activity. Limiting the dog's behavior by means of passive control strategies (e.g., crating and tethering) in the absence of constructive training efforts can be equally harmful to the human-dog bond and the dog's quality of life. In both instances, the dog's ability to establish predictive control over appetitive and social rewards needed to optimize its adaptation and security (comfort and safety) are impeded or blocked. Setting limits by means of varying degrees of force (dominance) or restriction can be highly beneficial for the dog, but only if the dog is simultaneously shown alternative means to obtain the gratification that it seeks to obtain. Impeding the dog's ability to escape or avoid an aversive situation by punishing an unacceptable mode of behavior (e.g., separation distress barking or whining), but without helping it to discover an alternative way to escape, avoid, or cope (e.g., providing it with an alternative or compensatory source of reward) from the aversive state (e.g., isolation and loneliness), may only tend to generate additional distress and focalize a point of ongoing conflict and tension between the owner and dog. Thwarting the dog's ability to obtain appetitive and social rewards by punishing unacceptable behavior (e.g., jumping up, barking, digging, chewing, pulling, and mouthing), without at the same time teaching the dog more acceptable means to produce equal or better reward opportunities, only serves to focalize conflict and tension between the dog and the owner over the acquisition and control of those thwarted reward opportunities.

From the cynopraxic point of view, these interactive conflicts and tensions oppose the objectives of interactive harmony and mutual appreciation, and, as such, represent the specific target areas of therapy efforts aimed at enhancing the human-dog bond. In addition, interactive conflicts and tensions precisely define the various social and biological needs that are not being adequately met by means of the relationship, thereby offering opportunities to improve the dog's quality of life significantly. Cynopraxic training is based on the assumption that interactive conflicts and tensions are resolved by teaching the dog alternative and mutually acceptable means to obtain the sought-after activities and rewards. In the process of dog owners being counseled about the sources and causes of interactive conflict and tension, owners learn about canine needs and become progressively appreciative of them, especially as they learn how to use them constructively in the process of improv-

ing their ability to control the dog via integrated compliance training (ICT). ICT refers to a training strategy that objectifies interactive conflicts and tensions as potential sources of reward for the dog, on the one hand, and opportunities for enhancing owner control efforts, on the other—a win-win exchange in the service of cynopraxic goals. ICT promotes social competence, cooperation, and trust via the mutual success of the owner and dog to establish predictive control over each other's behavior in the process of seeking and gratifying their individual needs by means of gratifying the needs of the other. Instead of standing in the way of the dog's appetitive and emotional gratification (comfort and safety), the owner becomes a cooperative and trusted partner in the process of acquiring attractive outcomes and avoiding aversive ones. The resultant reduction in interactive conflict and tension gives rise to social competence and trust, increased confidence and relaxation (the cognitive and emotional corollaries of social competence), and a foundation for interactive harmony and mutual appreciation. These various elements and outcomes of training play a significant role in cynopraxic counseling and canine behavior therapy, providing a platform of preliminary cognitive and emotional organization for approaching a wide spectrum of canine behavior problems.

Organized training activities not only systematically influence overt social behavior, they also serve to produce a broad spectrum of emotional changes (Rolls, 2000) (Figure 1.1). Classical conditioning and instrumental learning processes interact at various levels of cognitive and emotional organization, with appetitive and emotional attractive and aversive stimuli instigating a variety of emotional and motivational changes (see Rescorla and Solomon, 1967). In addition, a dog's cumulative successes or failures to control significant attractive or aversive events are reflected in persistent emotional changes and its disposition to learn and adjust. For example, establishing reliable predictive control over attractive and aversive events appears to promote enhanced mood and optimistic expectancy biases—a "better state" of being (Wyrwicka, 1975). Finally, training activities improve

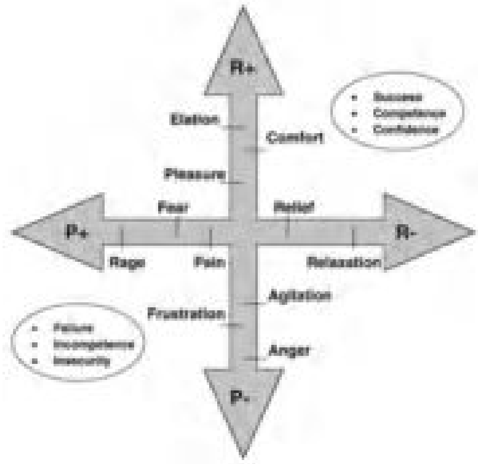

FIG. 1.1. Training events are associated with the production of a variety of emotional states that exert pronounced effects on mood and reactive behavior (see Rolls, 2000).

attentional functions and impulse-control abilities, as well as reduce adverse anxiety and frustration via increasing competence, confidence, and relaxation. Essentially, all training activities function as attention and impulse-control therapies in the context of developing useful behavior. As the result of effective training, dogs appear to adopt a more focused, relaxed, secure, and trusting attitude toward the social and physical environment, helping them to cope more effectively with conflict or emotionally stressful stimulation.

In addition to the various benefits of cynopraxic training for dogs, owners stand to gain from the experience. As the result of training their dogs, owners learn how to observe behavior, to appreciate a dog's biological and emotional needs, to communicate more effectively, and to develop a more informed estimation of a dog's cognitive capacities and limitations—all leading to a better relationship with the dog. Also, during introductory lessons, owners learn basic learning principles while practicing skills and techniques of behavior modification. In addition to reducing interactive conflict and tension, the progress and success that owners experience during these early lessons (e.g., training a dog to walk on-leash, to come

when called, to sit and lie down on command, and to stay) help to generate a more constructive and optimistic attitude about the dog's responsiveness to behavior therapy efforts.

Specific Benefits of Various Exercises

Dogs with behavior problems often benefit from systematic training before advancing to the implementation of more specialized behavioral procedures. In addition to general benefits, the practice of various trained exercises and tasks provides specific benefits relevant to the enhancement of canine behavior therapy efforts:

Orienting and Attending Response

Training the dog to reliably turn and focus its attention toward the trainer is a vital aspect of behavior control and management. In the absence of attention control, it is not possible to efficiently control impulsive behavior or responses operating under the influence of extraneous sources of reward (distractions). The direction of a dog's attention is defined by moment-to-moment motivational changes and intentional shifts preparing it to act on the environment. All purposive behavior is determined by shifts of attention, intention, and action functionally integrated and directed toward the environment in response to some motivationally significant imperative or impulse. Orienting and attending behavior promotes organized behavior. Without an ability to orient and selectively focus attention, the senses would be overwhelmed by the surrounding flux of environmental stimulation. As an adaptive interface between internal imperatives (establishing operations) and the external environment (a field of activity and choice), attention mediates action with the goal of increasing environmental predictability and control. Attention, intention, and action are intrinsically dependent on one another via a complex network of modulating interactions and feedback relations that are strongly influenced by the complementary effects of reinforcement (success) and punishment (failure). Attention therapy plays an important role in the treatment of a variety of behavior problems occurring in association with impulse-control deficits. Attention is related to impulse control as a hinge is to a door, such that the hinge defines the full range of the door's movements. Controlling a dog's attention is virtually tantamount to controlling the full-range of the dog's behavior, whereas losing a dog's attention to environmental distractions leverages control away from the trainer. In extreme cases of behavioral disorder, a dog's attention may become "unhinged" as attention and orienting responses become overstrained and disturbed, resulting in reactive and impulsive behavioral disorganization (see *Locus of Neurotogenesis* in Volume 1, Chapter 9).

Sit-Stay and Down-Stay

The sit response is an instrumental control module that every dog owner should master and practice with their dog under a wide variety of situations. Sitting on command is rapidly conditioned, produces a significant amount of control, and requires a minimal amount of instruction. Stay training strengthens inhibitory processes and impulse control, increases delay of gratification capacities, and promotes deference to owner control efforts. Training dogs to sit and stay on command for food, petting, and other rewards in everyday situations provides a simple and effective way to obtain improved cooperation and compliance. The rapid success and control produced by training dogs to sit and stay may have a highly beneficial effect on owners needing a ray of hope. In the late 1960s and early 1970s, David Tuber and Victoria Voith happened upon the value of preliminary reward-based sit-stay training in the context of treating fear-related behavior problems. As Voith recounts,

> Firstly, it gave the owners something to do between the first and second visits (which were a week apart). This gave us time to discuss the problem and develop a detailed, individual behavior modification program for that case.

> Secondly, most of our programs involved a classical conditioning component designed to change the emotional/physiological response to specific stimuli, e.g., loud noises, frightening people or other animals, distress responses etc. It was advantageous to have the dog stationary as the stimuli were introduced and it was essential that learning sit-stay be fun, non-punitive, not forced in any way and pleasant. No leash correction, no stern voices. The reward for the act of sitting and then remaining so for progressively longer periods of time was a mouth-watering tidbit. Needless to say, the dogs learned to sit and stay within a few minutes. But the dogs were not only learning an operant response; they were associating pleasant experiences (delicious food, praise from owner) with the verbal cue "sit" and the act of being in a sit-stay. A week of simple sit-stays was also teaching the owner how dog's learned.
>
> When we saw the dog a week later, the sit-stay (or down-stay) kept the dog in one spot, allowing us to gradually introduce other stimuli and to easily pair food rewards with the introduction of stimuli. In addition, the verbal cues and the act of sitting and staying also acted as conditioned stimuli, evoking pleasant emotional responses. The pleasant emotional states associated with sit-stay contributed to the classical counterconditioning paradigm and even could be a conditioned reinforcer when food was no longer presented. (Voith, personal communication, 2002)

The method was further developed and refined by Voith while she directed the Animal Behavior Clinic at the University of Pennsylvania. Voith's Sit-Stay Program involves dozens of discrete sit-stay tasks and variations of increasing difficulty (Voith, 1977b; Marder and Reid, 1996) (see Appendix A). Although not always appropriately credited to her as the originator, variations of her Sit-Stay Program and her Nothing in Life Is Free (NILIF) protocol (Voith, 1977a) are widely recommended by veterinarians, trainers, and applied dog behaviorists as a preliminary platform of control for carrying out counterconditioning procedures. Practicing sit-stay variations under varying environmental and motivational conditions promotes better attention and impulse control abilities. Together with the wait, controlled walk, coming when called, and down-stay exercise, sit-stay plays a prominent role in ICT. Finally, the sit-stay is frequently used as an incompatible response in various instrumental countercommanding procedures.

Controlled Walking

Every dog should be trained to walk on leash and collar without pulling. Such training is imperative in the case of dogs exhibiting behavior problems associated with attention and impulse-control deficiencies. Training the dog to walk on a slack leash is a necessary step toward enhanced deference to trainer-control efforts while in the presence of highly distracting or provocative stimuli. Since the dog must actively defer to every step and change of direction that the trainer takes, without impulsively chasing after other animals or objects that may be encountered, the process yields rapid and significant attention and impulse-control enhancement, especially if it is combined with sit and sit-stay training. Controlled walking consists of training the dog to walk at the left side with its hip aligned with the trainer's left leg. Although the dog can move back from this position, it cannot move ahead of it. Training the dog to walk on leash in a controlled manner allows the trainer to move the dog about in a controlled manner. This enhanced control of movement is useful when exposing the dog to potentially provocative situations, such as during graduated exposure procedures. A dog that is responsive to leash control can be more readily moved toward or away from provocative stimulation, thereby increasing the trainer's ability to perform controlled exposures to target stimuli during counterconditioning and desensitization efforts. The ability to precisely control exposure gradients decreases the risk that a dog will react adversely during such training activities. In combination, these aspects of controlled walking significantly enhance the effectiveness of response prevention and counterconditioning procedures. Training a dog to defer to leash limits and to follow prompts and signals while on leash appears to enhance significantly the leader-follower bond and the dog's overall willingness to cooperative. Finally, a major benefit of training a dog to walk on leash without pulling is that it is likely to

result in the dog getting more walks and going more places with the owner.

Quick-sit

The quick-sit is conditioned in the context of controlled walking. The dog is trained to sit rapidly and without hesitation, and remain in the sit position until the trainer releases it. Consequently, in addition to sitting rapidly, quick-sit training places a high priority on conditioning the dog to remain in the sit position regardless of environment distractions. Quick-sit is an emergency response that means "sit and stay," period. The quick-sit is practiced under a variety of increasingly distracting and adverse conditions. The training exercise promotes alertness, enhanced attention and impulse control, and readiness to respond cooperatively and obediently under adverse conditions. The exercise is useful as platform for various behavior-therapy procedures and is particularly helpful in the case of dogs exhibiting offensive aggression toward other dogs or various chasing problems.

Down, Down-Stay, and Instant-down

Down training builds on control established during sit-stay training. The down-stay is used in situations requiring that the dog defer and stay in a relaxed manner for long periods. Down training is particularly useful in the control and management of overly active and intrusive dogs. In adult dogs, resistance and oppositional tendencies may be momentarily intensified during down training. Down training provides a means to work systematically through such resistance constructively. In addition to down and down-stay, impulsive dogs should be trained to go to a spot and lie down on command without hesitation. Similar to the quick-sit, the instant-down promotes increased cooperation and compliance to command in emergency situations.

Starting Exercise

Dogs should be trained to a high degree of proficiency to move to the trainer's left side and sit there. The starting exercise requires that the dog turn away from distracting or arousing stimuli and either hook around at the trainer's left side or move to the rear of the trainer before crossing over to the left and sitting automatically. The control established by means of the starting exercise has many applications, such as establishing or enhancing control during greetings with visitors or bringing the dog back under closer control while on a controlled walk. All the basic elements of attention training are incorporated into the starting exercise.

Heeling

As an organized and coordinated activity, heeling requires that both the trainer and the dog concentrate on the actions of each other, promoting enhanced connectedness, common purpose, and leader-follower bonding. While heeling, the dog remains close at the trainer's side, keeping pace with abrupt and frequent changes of pace, following directional changes, and responding to stop and go actions by sitting or standing up. These various coordinated movements reflect the development of a signaling system of increasing subtlety and refinement. In contrast to the passive nature of static tasks such as sit-stay and down-stay, controlled walking and heeling are dynamically organized, consisting of responses sequentially entrained in accordance with the trainer's movement and body position relative to the dog. In an important sense, heeling is *moving-stay* exercise. The high level of positive reinforcement and inhibitory training associated with the conditioning of controlled walking and heeling provide a platform of control that competes with undesirable behavior, making counterconditioning efforts and the differential reinforcement of other, alternative, or incompatible behavior more efficient and likely to succeed.

Recall and Halt-Stay

A dependable willingness to walk on leash without pulling and to come when called is the mark of a successfully socialized and trained companion dog, whereas persistent pulling and refusal to come when called is the mark of an untrained or improperly trained dog. The amenable habit of staying close when off leash or coming when called despite

the presence of competing distractions signifies the presence of a leader-follower bond of sufficient strength to withstand the intrusion of external diversions and temptations. Freeze training is a routine aspect of recall training. When properly introduced and conditioned, the halt-stay module serves to interrupt highly motivated behavior decisively, enhancing the trainer's control over seeking excesses and dangerous impulsive behavior. Instead of running out of control when off leash, dogs should be trained to orient, come, or halt instantly in place and wait where they stand until *reached, recalled,* or *released* by the trainer—the 3 R's of halt-wait training. Effective recall and halt-stay training provides dogs with numerous quality-of-life benefits, serving to free them to enjoy the environment while minimizing the risk of harm to them as the result of being off leash. The recall and halt modules are critical and should be trained to a high degree in advance of letting dogs off leash to play and enjoy an open or public environment. Even in the case of dogs not let off leash in such places, the recall and halt modules should be trained to a high degree of reliability to prevent accidental injury as the result of bolting from the car or house. Many common problems are obviated by solid recall and halt-stay training.

BEHAVIORAL EQUILIBRIUM

Basic training should be performed with an eye toward balancing exercises with opposites in order to prevent a dog from becoming overly expectant and reliant on some set of behaviors to the exclusion of others. A dog that is repeatedly prompted to lie down from the sit, but not the other way around, might prove more difficult to train to perform the reverse action of sitting from the down; similarly, a dog that is exclusively trained to sit, without being occasionally prompted to stand, may be more difficult to train to hold a stand or stand-stay later on. Consequently, basic exercises are balanced by patterning their sequence in various ways. For example, heeling closely at the trainer's side is balanced by opportunities to walk freely. Staying in place is balanced by opportunities for increased activity, including heeling, recall, and release for play. Movement away from the trainer is balanced with stopping and returning exercises. Taking objects from the hand is balanced by prompting the dog to release them. Fetching objects is balance by training the dog to avoid certain objects. Waiting at doorways is balanced by release cues, move-away signals, or come-along signals. Lying down is balanced by having the dog sit or stand from the down position. The sit response is balanced by prompting the dog to stand. The automatic sit is balanced by an exception cue signaling the dog to stand or stand-stay instead of sitting. Going to heel (start and finish) is balanced by having the dog learn to go back to front from the trainer's side. A balanced repertoire of directional tasks can be extremely useful. Dogs can be easily trained with vocal signals and hand prompts to stop, back, move forward, turn left, turn right, and turn about. Not only do such activities improve a dog's attention abilities, they also enhance the trainer's ability to precisely control the dog's behavior at a distance. Many additional examples of behavioral equilibrium could be listed following the same basic pattern in which the type, direction, and function of any given item in a dog's repertoire is matched with its behavioral opposite.

Balance should also be considered when modifying common nuisance problems. When dogs are trained to limit excessive barking, they should also be trained to bark on signal. Similarly, dogs trained not to jump up should also be trained to jump up on cue under appropriate circumstances. Prompting a dog to stop some activity ("Enough") is balanced by releasing it to engage in another activity. In addition to mixing modules and routines to prevent imbalances, trainers should take care to balance emotional and sensory stimulation. For example, bouts of energetic play should be balanced with periods of inhibitory restraint (e.g., stay and wait training). Experiences causing fearful arousal should be followed by stimulation evoking relaxation or other responses incompatible with fear. Activities resulting in close attachment should be balanced by periods of separation. Assertions of control resulting in submissive behavior are balanced by affectionate

reassurance and opportunities for the dog to compete in constructive ways. Competitive interaction is balanced by engaging the dog in cooperative activities, and so forth. In general, emotionally inhibitory activities are balanced by excitatory ones and vice versa. Organizing behavioral opposites to occur in close association with one another provides a significant source of reinforcement and punishment. For example, releasing the dog from a sit-stay provides a powerful reward for staying, while, conversely, having the come to sit and stay may exert a punitive effect on its willingness to come in the future when called.

Signals and Communication

Dog-training signals use a variety of sensory modalities, with visual, auditory, and tactile signals playing a prominent role. Visual signals include all forms of bodily movement and gesture designed to influence dog behavior in some way. There are both formal and informal visual signals. Formal hand signals are used to inform or reinforce vocal signals issued at a distance. Informal signals are used to communicate an intention or expectation to a dog by directly stimulating some action; for example, running away, crouching down, or clapping the hands can prompt the dog to follow or come. Dogs are also highly responsive to directional gazing and pointing. Apparently, the dog's ability to take instruction by pointing and other gestures (bowing, nodding, and head turning) has been enhanced by selective breeding and learning (McKinley and Sambrook, 2000). Such communication represents a significant form of interspecies exchange between people and dogs (Miklósi et al., 1998). As a result, most dogs can quickly learn to follow directional cuing with minimal practice.

Ideally, training signals should be presented in an orderly way with the least informative signals preceding more informative ones and concluding, if necessary, with directive prompts and physical guidance. Besides being well organized and presented in an orderly manner, these various signals, especially vocal ones, must be well differentiated. The greatest potential for confusion arises when signals are used inconsistently or when they are presented in a manner that makes them difficult to discriminate. To avoid this source of confusion, vocal signals are presented in distinctive tones of voice, depending on their intended purpose.

Vocal signals are used to perform a variety of functions, including conditioned reinforcement, that is, bridging a contingent response with a future reward (e.g., "Good," "Yep," "That's it," and "Yes"), conditioned punishment (e.g., "No," "Eh," "Ack," and "Nah"), and cuing or command (e.g., "Sit"). Vocal praise and directive reprimands (e.g., "Enough," "Stop it," "Leave it," and "Off") serve to produce more general activating or depressing effects on behavior via both conditioned and unconditioned effects of tone of voice on dog behavior. To minimize confusion, vocal signals are spoken in a distinctive and consistent tone. The loudness and tone of vocal signals and the way they are presented are shaped in conformity with the changes that the trainer wishes to make in a dog's behavior. The reprimand is spoken in an assertive tone of voice from the belly; the command is spoken in a clear, normal tone of voice from the chest and throat; and praise is spoken in a lively, friendly, and high-pitched tone of voice from the mouth and throat. The volume of voice is adjusted from soft to harsh for purposes of emphasis. Good communication with the voice depends on keeping these various tones and their intended functions distinct by not saying commands like praise, issuing a reprimand like a command, or delivering a command like a reprimand. Many signals function as establishing operations motivationally shifting behavioral thresholds and making the occurrence of certain classes of behavior more likely while making other classes of behavior less likely. Besides regulating a dog's behavior, tone of voice also serves to modulate the dog's mood and attitude during the training process. The lower and assertive barklike reprimand may trigger innate mechanisms mediating behavioral inhibition and deference (see *Sensory Preparedness* in Volume 1, Chapter 5).

Although dogs are surprisingly clever at deciphering the associative implications of words, they do not seem to understand words

as conceptual constructs. In addition to associative meanings, words signify concepts and relations extending well beyond the reach of a dog's understanding. Concepts are mental representations of related things, and words stand in a symbolic relation to concepts. In addition, words are part of a language system articulated by grammatical rules and syntax to enable us to communicate with one another in meaningful ways. To dogs, words are auditory *images* deriving their *meaning* through associative contiguity with the regular occurrence of some thing, action, or relation in the presence or close association with the vocal signal. According to Hobbes (1651/1994), the dog shares with people an imagining faculty that facilitates such understanding and appreciation of words:

> The imagination that is raised in man (or any other creature endued with the faculty of imagining) by words, or other voluntary signs, is that we generally call understanding, and is common to man and beast. For a dog by custom will understand the call or the rating of his master; and so will many other beasts. That understanding which is peculiar to man is the understanding not only his will, but his conceptions and thoughts, by the sequel and contexture of the names of things into affirmations, negations, and other forms of speech: and of this kind of understanding I shall speak hereafter. (11)

Along with the associative meanings and implications of vocal signals, the tonal variations in which vocal signals are given help to communicate a trainer's emotional state and immediate intentions to a dog. The dog may not appreciate the symbolic or conceptual significance of a word, but it does appear to be extremely sensitive and responsive to the feeling content of vocal signals reflecting the will of the speaker.

The language barrier between people and dogs causes many dog owners to both overestimate and underestimate their dog's capabilities. Some of the difficulty can be attributed to the facility with which we transform experience into mental representations (thoughts and images) that are almost automatically arranged into logical relations and configured into concepts fitted to words. Words give us the ability to represent experience symbolically in terms of causal relations, connecting long-past events (causes) to current or future events (effects). A dog's experience is more temporally confined and limited to the immediate demands of existence surrounding the moment (Roberts, 2002). The stream of life passes by with all its disappointments and adventures, with each moment lived to the fullest or lost. A dog has little time to ruminate on past events or future possibilities, except to the extent that they directly impact on the present moment. Unlike people, dogs lack the symbolic, conceptual, and logical means to connect long-past events and actions with the present moment; that is, they appear to lack an episodic memory. Dogs exist in an ever-present and perpetually becoming *now.*

The dog is remarkable among animals by its willingness to work for affection and approval from a human handler (Kostarczyk, 1991). The dog loves to please, first of all itself, of course; but after some basic training it will work to obtain various social expressions of affection, such as petting, gentle caresses, and praise. Although a brief high-pitched vocal signal like "Good" is preferable for refined training purposes, periodic longer phrases of vocal praise and sweet talk can be extremely useful and beneficial as a means to enhance a dog's incentive to work for social rewards. The vocal bridge "Good" functions as a conditioned reinforcer and exactly refers to some specific behavior, whereas affectionate praise and sweet talk relate more generally to a dog's willingness to work and cooperate. Sweet talk both reassures and encourages dogs. Praise also keeps the training process from becoming too clinical and boring, helping to keep the atmosphere cheerful and fun for dogs and trainers. Gentle, but firm, petting and soft embracing hugs with endearing words are well received by most dogs. As a cynopraxic activity, training is always concerned with ways of maximizing bond and quality-of-life benefits; rather than pursuing the training process with excessively sterile and rigid procedures, cynopraxic training incorporates affectionate means and play whenever possible. Praising and petting is an art that should be given from the heart as a sincere expression of affection and appreciation in response to a dog's behavior and

accomplishments. Nervous finger tickling, fidgeting, and hard shoulder slapping are not usually well received by dogs in training, although many do appear to enjoy a friendly shoulder pat now and then. The key to effective petting is its intention and sincerity. If the heart is not in it, it would be better not to pet the dog—the dog knows the difference. Of course, dogs exhibiting aggression problems should only be handled and touched with appropriate care and precautions.

Attention and Impulse Control

Attention provides a selective interface between the internal and external environment, helping dogs to detect and control events and situations that have motivational significance for them (see *Attention and Learning* in Volume 1, Chapter 7). Attention, impulse (the combined activation of relevant control expectancies and establishing operations), intention, and action are closely linked by a network of classically conditioned predictive associations that inform and motivate instrumental control efforts (see *Basic Postulates, Units, Processes, and Mechanisms* in Chapter 10). When attention falls upon a motivationally significant (salient) object, a control incentive may be aroused, followed by the activation of preparatory responses and intentional movements or orientations in anticipation of overt control efforts (see *Control Incentives and Reinforcement*). Under the influence of appetitive arousal, attention functions may be recruited by control incentives to coordinate instrumental modules and routines leading to gratification (comfort seeking). As the dog commits to a course of action, its attention may be locked or *vectored* on the developing situation and dedicated to the acquisition and processing of real-time information relevant to adjustments conducive to instrumental success. Once launched, highly motivated behavior may only stop after it is consummated (confirmed), fails (disconfirmed), or is interrupted by the evocation of an antagonistic control incentive having a greater motivational significance and priority. In practice, the inhibitory control over impulsive behavior is often accomplished by means of startle or momentary discomfort. The startling event produces a rapid diminution of appetitive arousal while at the same time establishing an incompatible control incentive aimed at escaping the unexpected and dangerous situation (safety seeking). As a result, the appetitive control expectancy is modified to include an element of danger, thereby increasing the dog's responsiveness to inhibitory signals and avoidance when engaged in similar activities in the future.

Although such control efforts are often necessary and expedient for gaining control over certain impulsive behaviors, the routine induction of fear or discomfort to establish control over impulsive behavior risks various adverse side effects, especially in cases where such training is performed incompetently or in the absence of reward-based alternatives. Once a dog is acting on a strong impulse, attempting to interrupt it by means of threats and belated punishment is analogous to grabbing an ox by the tail and whipping it in order to stop it from running away. Of course, a more sensible approach for controlling such a powerful animal is to guide it by means of a rope and nose ring while luring it forward with a clump of fresh hay. Similarly, keeping the dog on a long line or leash and conditioning a strong orienting and attending response in the context of shaping a variety of basic exercises (modules) and skills effectively facilitates enhanced attention and impulse control while reducing the amount of aversive inhibitory training needed to gain reliable off-leash control. The key for effective attention and impulse control is anticipating and capturing the dog's attention in advance of it becoming absorbed by competing environmental sources of reward. Capturing and diverting a dog's attention toward comparable or better sources of reward under the trainer's control is akin to the ox's nose ring, giving the trainer a high degree of leverage for controlling undesirable impulses. In addition to employing preemptive attention-control efforts, the intensive training of orienting and attending behaviors with techniques that produce positive prediction error can significantly improve attention and impulse control and reduce the use of aversive techniques. Atten-

tion control is established by means of both instrumental and classical conditioning mechanisms. For example, a dog's name is first and foremost learned as a discriminative stimulus for controlling the dog's attention; the dog can choose to attend or not when it hears its named called. However, attention (orienting response) is also controlled by a reflexive mechanism. Given a sufficiently salient and unexpected stimulus, such as an unusual sound, a dog—willing or not—will start and orient toward the source of stimulation. Pairing the dog's name with such unconditioned orienting stimuli (e.g., squeak, smooch sounds, clapping, and so forth) and bridging the orienting response with surprise-producing rewards can rapidly enhance the nominal signal's ability to control a dog's attention.

To attend (Latin *attendere,* to heed) and to obey (Latin *oboedire,* to listen) are functionally dependent and intrinsic aspects of the basic training process. Improving a dog's attention and impulse-control abilities by training it to actively listen to and heed human guidance and directives is among the most important core objectives of basic training. When properly understood and performed, training that establishes attention and impulse control serves to form and preserve a shared moment of mutual awareness and consideration (mutual appreciation) while reducing interactive conflict and tension via reward-based training efforts. The cynopraxic process is tantamount to leading the aforementioned ox by means of its nose ring and desire for hay, then letting go of the rope, eventually forgetting about the ox's training, and finally just enjoying the companionship and walk. The mutual exchanges and transactions between the trainer and dog that compose the training process are mediated by the establishment of an attentional nexus bringing the trainer and dog into the same time frame for the sake of mutual benefits derived from their cooperation (interactive harmony).

INTERRUPTING BEHAVIOR

Establishing control over a dog's attention often involves the use of diverters and disrupters to interrupt ongoing behavior. Diverters rely on an element of surprise and attractiveness to turn a dog's attention away from some competing activity. Disrupters, on the other hand, depend on startle and alarm to gain a dog's attention. Interrupting diverters and disrupters may momentarily intensify attention and enhance learning by activating behavioral inhibition and other rapid adjustments via prediction-error signals occurring in response to the detection of a dramatic incongruence or mismatch between what the dog is accustomed to expect and what is happening. With the occurrence of surprise or startle, a brief hesitation or halt in activity may occur while the discrepant information is cognitively and emotionally processed and integrated before the dog's previous activity is resumed or another activity is begun. The effectiveness of diverters and disrupters is influenced by a variety of factors, including previous exposure to the event (see *Latent Inhibition* in Volume 1, Chapter 6), habituation and sensitization, and the presence of other stimuli (e.g., fear-potentiated startle and prepulse inhibition) (see Koch, 1999). In the case of fear-potentiated startle, a previously conditioned fear-eliciting stimulus may serve to potentiate the startle produced by the disrupter. On the other hand, the presence of a conditioned aversive stimulus may decrease the effectiveness of a diverter to attract and hold the dog's attention (see *External Inhibition and Disinhibition* in Volume 1, Chapter 6). An attenuated stimulus (distraction) occurring immediately before the disrupter is delivered may significantly decrease the startle response elicited by the event via prepulse inhibition (see *Prediction and Control Expectancies*). Despite their potential to reward or punish behavior, diverters and disrupters are not conceived of as producing reinforcement or punishment, until the dog produces behavioral efforts aimed at controlling their occurrence (see *Diverters and Disrupters* in Volume 1, Chapter 7). Diverters and disrupters function primarily as generic establishing operations serving to mobilize control incentives and to launch control modules, routines, and modal strategies in accordance with anticipated needs. Although not productive of reinforcement and punishment initially, consequent presentations of diverting

and disrupting stimuli may function as reinforcers or punishers to the extent that a dog is able (reinforcer) or unable (punisher) to predict and control them. Diverters and disrupters play a major role in the control of a wide variety of dog behavior problems (see *Diverters and Disrupters*).

Particular care must be exercised when using diversionary techniques to control behavior problems, since, if improperly used, such procedures can easily result in unintentional reinforcement rather than simply diverting a dog's attention or initiating an incompatible establishing operation. If a dog is repeatedly diverted from some unwanted activity by offering it the opportunity to perform some other more desirable activity, it may gradually learn that the desirable activity can be obtained by engaging in the unwanted behavior. In this case, the diverter is no longer functioning as a diversionary stimulus but has become a positive reinforcer. This risk is always present when a diverter is repeatedly presented in the absence of other training activities, whereby other (DRO), alternative (DRA), or incompatible (DRI) behavior is reinforced following the evocation of a diversionary establishing operation (see *Differential Reinforcement* in Volume 1, Chapter 7). Diverting a dog from one activity to engage in another one usually means that the second activity is motivationally located higher up on the dog's response-priority hierarchy, making it likely that the diversionary activity could function as a positive reinforcer (see *Premack Principle: The Relativity of Reinforcement* in Volume 1, Chapter 7). For example, a dog racing through the house or grabbing personal belongings may be diverted from the activity by picking up a leash, signaling a possible walk. If a walk follows regularly at such times, the dog may learn to control the opportunity to go for a walk by engaging in rambunctious behavior. In this case, the lower-priority behavior (racing through the house) is instrumental in obtaining the higher-priority behavior (going for a walk). For owners of such dogs, it may not be clear to them that the pattern of picking up the leash is not only serving to stop the unwanted behavior but is also inadvertently helping to maintain it. In fact, an owner may be quite gratified by the momentary success achieved by getting the leash whenever the dog appears out of control. In sum, the outcome is a *behavioral trap* in which short-term control is achieved at the expense of increased undesirable future behavior (Tortora, 1980).

Bribes and threats may be confused with diverters and disrupters, but function in very different and problematic ways. Dogs are commonly bribed after they have refused to come when called. Although the offer of a food bribe may cause a resistant dog to come, the bribe also directly reinforces the refusal behavior. As the result of repeated bribery, the refusal behavior may actually become stronger than the dog's interest in obtaining the offered food bribe, causing the owner to produce something even better to gain the dog's resistant compliance. Improving the bribe serves only to strengthen the refusal behavior further and so on, with the *bribe trap* progressively leading to a deterioration in the dog's willingness to come when called. Unenforceable threats following misbehavior or refusal to obey can be equally problematic. Under the influence of empty or inconsistently enforced threats, a dog's unwanted behavior may increase as it finds that the threatened consequence is not forthcoming, causing it to experience a significant amount of relief by evading the owner's punitive efforts successfully. Furthermore, in the case of the *threat trap,* because some percentage of threats are effective, the owner's threatening behavior is intermittently reinforced and may persist despite a progressive deterioration of overall control. Dogs exposed to such treatment quickly learn that staying away at a safe distance insulates them against any real consequences associated with threats. Consequently, rather than helping to suppress unwanted behavior, repeated and ineffectual threats may serve only to encourage a dog to misbehave at a safe distance out of the owner's reach. In an effort to counteract the dog's defensive ploy, the impatient owner may complicate matters further by enticing the dog to come within his or her reach before grabbing it and delivering a dose of belated and self-righteous punishment. Although the owner may feel privately vindicated by a belief that justice had been served or some such

hokum, the only thing that a dog is likely to learn from such abusive treatment is to be more wary and difficult to catch in the future. In addition, such acts of calculated deception may rapidly train a dog to view the owner and others with distrust, thereby potentially setting the stage for more serious adjustment problems later.

TRAINING AND PLAY

In the process of describing the procedures and techniques of basic training, it is easy to lose sight of some of the subtle nuances and flavor, the sundry incidental activities and diversions (e.g., spontaneous playfulness and affectionate interaction), the rhythm and dancelike quality of the interaction between the trainer and dog, and the general presence of fun and excitement associated with training a dog. In fact, nothing is more important to successful training than play. Although food is a tremendously useful reward, excessive reliance on food should be avoided, and other sources of reinforcement should be identified and used to support training objectives, with the goal of actualizing the dog's whole emotional and behavioral potential. In addition to an appetite for food, dogs exhibit a wide range of other social and physical needs that seek gratification, but, most importantly, they need to play and they enjoy playing with people. Consequently, whenever possible, training objectives should be organized around play incentives. Playing with dogs makes them more flexible and willing to open their behavioral repertoire creative experimentation and change. In the context of play, social limits and rules are much more readily accepted and incorporated into everyday interaction. Play makes change and adaptation easier and more durable, seeming to promote a sense of joyful harmony and trust between people and dogs (The *Cynopraxic Trainer's Attitude* in Volume 2, Chapter 10). In the case of serious behavior problems, play often offers a valuable behavior-therapy modality for accessing and modulating affected emotional command systems (see *Modulatory and Unifying Effects of Play* in Chapter 6).

By means of modal play and exploratory activities, dogs interact with and adapt to the social and physical environment. In essence, dogs learn about people and their surroundings by playing and exploring (Trumler, 1973). In the context of instrumental control efforts, active modal play and exploratory strategies help to shape and entrain control modules, routines, and projects into patterns of instrumental behavior via the discovery of outcomes conducive to surprise (reward) and the avoidance of outcomes producing disappointment. Active modal strategies are activated (rewarded) or depressed (punished) by positive and negative prediction errors, respectively (see *Prediction and Control Expectancies*). Play appears to be particularly sensitive to the effects of positive prediction error, making it a potent source of reward and mood enhancement. The canine disposition to play and explore endows the dog with a high degree of curiosity and capacity for producing reward derived from the discovery of stimuli evoking positive prediction error and surprise. In addition to mediating reward, play appears to perform a special modal balancing and integrating function in relation to emotional command systems (see *Play and Drive* in Chapter 10). A lack of playfulness or an inability to sustain playful interaction is a reliable indicator of emotional imbalance, degraded mood, or disease. Given the social and quality-of-life objectives of cynopraxic training, it is natural that play should figure centrally in the process of behavioral change and adjustment (see *Fair Play and the Golden Rule* in Chapter 10). During playful interaction, both the dog and the trainer learn the value of compromise and cooperation; without mutual compromise and cooperation, playful interaction cannot be sustained. In contrast, time-out (i.e., loss of social contact and reward) has an opposite effect on modal activity and serves to mediate passive module strategies via disappointment and decreased reward incentive (de-arousal).

A spirit of affectionate playfulness should inform the training process. Training sessions frequently, but not always, start off with play, but formal sessions should always end on a playful note. Periodic bouts of play are interspersed throughout the session, bringing

trained modules and routines under the motivational influence of playful incentives. Training a dog to control playful impulses by turning them on and off again in the process of rewarding compliant behavior provides a powerful means to improve impulse control. As Hediger (1955/1968) once aptly noted, "Good training is disciplined play" (139). Spontaneity does not arise out of chaos, but is born under the nurturing influence of order, discipline, and play. As trained behavior becomes reliable (i.e., well predicted and controlled), first through reward training using social and appetitive reinforcers and then directive training conducive to enhanced competence, relaxation, and safety, further refinement and integration are achieved via the unifying influence of ludic incentives and play rewards. Play rewards gradually transform the significance of trained behavior via associative processes, whereby trained responses become progressively linked with playful affects, ludic incentives, and qualities (e.g., spontaneity and joy). Under the liberating influence of play rewards, trained behavior becomes more responsive to reorganization and generalization. Play makes the training process more creative for trainers and makes work more fun for dogs. Just as training sessions are started and concluded with play, play is both the means and the end of cynopraxic therapy.

The Training Space

Setting appropriate social boundaries and limits is an important foundation for all training activities. All dogs must learn to respect three basic boundaries at the outset of training: limits on jumping up, limits on biting on hands and clothing, and limits on pulling against the leash. In most cases, these behaviors are not entirely suppressed but redirected or modified into more acceptable forms. Although spontaneous jumping up is not permitted, dogs may be trained and permitted to jump up on cue. Similarly, while biting on hands and clothing is discouraged, biting on tug toys is encouraged with play. Since both jumping up and tug games are highly enjoyable activities for dogs, they can be invited to jump up or given opportunities to play tug as a reward. Similarly, from an early age, puppies should be discouraged from pulling by various means. Such boundaries are set by first causing the dog to passively defer and then to actively follow the trainer's rules of interaction, defining when it can jump up or bite. Besides learning to relinquish control and to desist from competitive challenges, the establishment of social boundaries enhances a dog's attention and impulse-control abilities. The limits and training set around jumping up, biting, and pulling form a training space within which reward-based training activities can be carried out. Without the establishment of a viable training space, training activities may be continuously frustrated by intrusive social excesses and oppositional behavior.

Instrumental Reward and Punishment

Just as objects acquire the appearance of form and solidity as the result of the interplay of light and dark on their surface, behavior is shaped through the complementary influences of reward and punishment. Practically speaking, behavior is formed and structured by systematically arranging reward and punishment to occur in ways that produce controllable behavioral changes consistent with immediate (proximal) and remote (distal) training objectives. The conventional definitions of reinforcement by reward and suppression by punishment stress the complementary effects that these events have on the frequency or probability of behavior as consequences, but without much reference to the emotional or cognitive processes mediating the observed effects (see *Basic Concepts and Principles of Instrumental Learning* in Volume 1, Chapter 7). This general characterization of instrumental learning by reward and punishment, founded on Thorndike's law of effect, appears to be overly simplistic and theoretically inadequate for capturing the complex and organized nature of adaptive learning processes. The conventional view neglects critical molar and modal aspects of learning and behavioral organization, perhaps as the result of an excessively myopic emphasis on molecular relations

between consequent events and isolated responses. Of particular interest from the perspective of cynopraxic behavior therapy and training are the acquired molar relations operating under the organizing influences of emotional and cognitive processes.

Control Incentives and Reinforcement

The effects of reinforcement and punishment are quantified by reference to the differential changes that the events have on response probability or frequency. However, defining reinforcement and punishment in terms of probability is rather circular and inadequate for several reasons (see *Reinforcement and the Notion of Probability* in Volume 1, Chapter 7). Alternatively, reinforcement and punishment can be viewed from the perspective of a control incentive and function. According to the control-incentive theory, behavior that enhances an animal's control over significant events produces reinforcement whereas behavior that impairs control efforts results in punishment. Changes in the frequency or probability of the reinforced or punished behavior are secondary to its success or failure to improve an animal's ability to control the environmental event prompting action. The establishment and optimization of control over attractive or aversive events appears to be an important aspect of reinforcement and punishment for dogs. Dogs work to optimize their control over attractive events by obtaining or maintaining their availability; similarly, they work to escape, reduce, or avoid aversive ones. Normally, when a dog acts, it does so with the intent of producing some specific effect on the environment; that is, instrumental behavior is purposive and shaped by the accumulated successes or failures that such efforts afford with respect to the control of significant events. To the extent that these efforts are successful, they are reinforced and integrated into a dog's behavioral repertoire, whereas efforts that fail to control attractive or aversive events adequately are punished by loss or discomfort and are gradually modified or removed from a dog's behavioral repertoire, at least in those situations where the actions have failed to enhance control efforts. In short, according to the control-incentive theory, reinforcement occurs when purposive efforts succeed in enhancing a dog's control over some motivationally significant event, whereas punishment occurs when such purposive efforts fail to make a difference or make matters worse; that is, they result in a lack or loss of control.

Premack's interpretation of reinforcement and punishment is consistent with a control-incentive analysis (see *Premack Principle: The Relativity of Reinforcement* in Volume 1, Chapter 7). According to Premack, instrumental behavior is reinforced or punished by the occurrence of other behavior. The reward value of any particular behavior is determined by its probability of occurrence relative to other behaviors operating under similar motivational and environmental circumstances. Therefore, at any given moment, an animal's behavioral repertoire is distributed along a hierarchic continuum from behaviors that are least likely to behaviors that are most likely. Behaviors that are more likely tend to reinforce behaviors that are less likely, whereas behaviors that are less likely tend to punish behaviors that are more likely. In short, instrumental behavior is reinforced by other behavior occurring at a higher probability. Premack's response-probability hierarchy is really a control-incentive index. Obviously, responses of the highest probability are precisely those that would most likely lead to enhanced control over some immediate and motivationally significant event, whereas responses with low probability and reinforcement value are precisely those actions with the least likelihood of establishing control or those that may actually impair control efforts. Low-probability responses are potentially punitive, not because they are assigned a low probability or intrinsic hedonic value, but because they do not directly serve the animal's immediate control interests. High-probability responses are those that are most relevant or likely to succeed with respect to the control of motivationally significant events, whereas low-probability responses are those that are most irrelevant or likely to fail.

Although control incentives are functionally significant with regard to reinforcement and punishment, the gratification of a control incentive is not sufficient to explain the

organizing effects of learning. In addition to control incentives, various predictive influences are at work. In an important sense, instrumental control incentives appear to emerge in the context of classical conditioning. The predictive information produced by associative learning provides a framework for instrumental control efforts. Classical conditioning provides predictive information about the occurrence of significant events and prepares a dog motivationally for them, whereas instrumental learning is concerned with optimizing a dog's ability to control the events when they occur. The orderly nature of learning suggests that it occurs within the context of prediction-control expectancies. As argued in *Prediction-Control Expectancies and Adaptation* in Volume 1, Chapter 7, reinforcement and punishment are not so much about the effects of arbitrary attractive and aversive events increasing or decreasing the future probability of some isolated response, but rather the result of the confirmation or disconfirmation of instrumental control expectancies. Control expectancies are the encoded results of past instrumental efforts to exploit or avoid attractive or aversive events. Classical and instrumental learning activities share a common organizing function, viz., to make the environment more predictable, controllable and, consequently, more comfortable and safe.

Classical Conditioning, Prediction, and Reward

Successful control over significant events depends on the accumulation of predictive information concerning their occurrence. Classical conditioning not only provides predictive information about the occurrence of attractive and aversive events, it also establishes a complex network of predictive contingency relations between antecedent and consequent events that guides instrumental control efforts (see *Relations Between the Signal, Response, and Outcome* in Volume 1, Chapter 7). In addition to providing predictive information that is incorporated into instrumental control expectancies, classical conditioning significantly influences instrumental behavior via excitatory and inhibitory emotional influences (Rescorla and Solomon, 1967; Dickinson and Pearce, 1977). At the level of organizing functions, the conventional distinctions between classical and instrumental learning begin to dissolve. The successful control of significant events depends on the acquisition of accurate predictions regarding the details of their occurrence, size, and quality. Similarly, adequate prediction depends on feedback derived from instrumental control efforts.

Refinement of instrumental control efforts depends on information obtained from conditioned stimuli, especially those stimuli that are relevant to control efforts. In the process of training, for example, bridging stimuli (conditioned reinforcers) play an important role in the acquisition and maintenance of learned behavior. In addition to evoking various conditioned appetitive and emotional responses, bridging stimuli are informative about the size, type, and frequency of the pending attractive or aversive event. In fact, the ability of bridging stimuli to control and modify behavior appears to depend on their information value (Egger and Miller, 1962). Optimal bridging effects occur when new and surprising information is obtained about the occurrence of rewarding stimuli. The moment of reward is not when a dog ingests food or when it receives affectionate attention and petting, but, more precisely, reward occurs at the moment a dog detects some new bit of information that enhances its control over such motivationally significant events. Reward and punishment appear to depend on the detection of a discrepancy between what a dog expects to occur and what actually occurs: reward occurs when the outcome is better (more attractive) than expected (surprise), whereas punishment occurs when the outcome is worse (less attractive) than expected (disappointment). A similar relationship is obtained in the case of aversive events: reward occurs when the expected outcome is better (less aversive) than expected (relief), whereas punishment occurs when the outcome is worse (more aversive) than expected (startle). As the result of prediction discrepancies, conditioned reinforcers undergo excitatory or inhibitory changes in accordance with the Rescorla-Wagner model; that is, only

when the conditioned stimulus (CS) either underpredicts (excitatory) or overpredicts (inhibitory) the unconditioned stimulus (US) does additional learning take place (see A*ssumptions Derived from the Rescorla-Wagner Model* in Volume 1, Chapter 6). Three possible effects on the associative strength of the bridging stimulus occur in association with attractive and aversive outcomes:

1. If the outcome is more attractive or aversive than expected (surprise or startle), then excitatory conditioning occurs—the associative strength of the conditioned reinforcer is strengthened.
2. If the outcome is less attractive or aversive than expected (disappointment or relief), then inhibitory conditioning follows—the associative strength of the conditioned reinforcer is weakened.
3. If the outcome is exactly as expected (comfort and safety), then no additional learning occurs (the prediction is verified)—the associative strength of the conditioned reinforcer is unchanged.

Studies focusing on the response of dopamine (DA) neurons to the presentation of signals with varying temporal and predictive relations to rewarding stimuli indicate that the activation (reward) or depression (punishment) of reward-mediating DA neurons depends on the detection of discrepancies between what an animal expects and what actually occurs (Waelti et al., 2001). DA reward signals are generated in association with positive prediction errors (the attractive outcome is better than expected), whereas punitive signals are produced in association with negative prediction errors (the attractive outcome is worse than expected) (Schultz, 1998):

> All responses to rewards and reward-producing stimuli depend on event predictability. Dopamine neurons are activated by rewarding events that are better than predicted, remain uninfluenced by events that are as good as predicted, and are depressed by events that are worse than predicted. (1)

In essence, the collection of DA neurons localized in the ventral tegmental area generate teaching signals in response to the detection of prediction errors, thereby facilitating improved adaptation and organized behavior via an incentive to explore, experiment, and discover. These various behavioral and neurobiological findings complement the behavioral findings of Egger and Miller (1963) and lend support to their hypothesis that "reinforcement occurs primarily at the point at which new information is delivered" (132). As such, learning appears to depend on expectancy errors that variably lead to surprise and disappointment—errorless learning is an oxymoron. Outcomes that are well predicted and expected do not support additional learning, even though the attractive outcome consistently follows the learned behavior—a fully predicted reward appears to block additional learning (plateau). Such outcomes serve to verify the control expectancy, gratify the control incentive, abolish the establishing operation, and contribute to feelings of comfort and safety, but they do not produce reward.

As instrumental behavior becomes stable under the influence of repeated bridging and reinforcement, DA release shifts to the earliest predictor of impending reinforcement, viz., the bridging stimulus (Schultz, 1998) (Figure 1.2). DA activation via bridging stimuli exhibits a preference for stimuli with a clear onset and alerting quality. Also, DA neurons are exclusively sensitive to the onset of the bridging stimulus and are unresponsive to its offset, even if the offset coincides with the delivery of the rewarding stimulus (Schultz, 1998). These findings suggest that the bridging stimulus should be brief and crisp and have an alerting quality, helping to explain the bridging efficacy of brief high-pitched vocal sounds, squeakers, whistles, and clickers. The conditioned effect of bridging stimuli may be mediated via efferent pathways originating in the amygdala (Hassani et al., 2001). The lateral nucleus of the amygdala contains neurons that are highly sensitive to acoustical stimulation, which play an important role in the detection of auditory conditioned stimuli. In addition to receiving afferent acoustical signals via the thalamus and sensory cortex, the amygdala forms strong efferent connections with DA neurons in the

ventral tegmental area (Schultz, 1998), lending some credibility to the hypothesis that the amygdala may be involved in the process of conditioned reinforcement. In any case, noradrenergic pathways also probably play a role, since norepinephrine (NE)-producing neurons originating in the locus coeruleus exert a potent excitatory effect on numerous forebrain areas mediating orienting and alerting responses to conditioned appetitive and aversive stimuli, as well as novel or startling ones (see *Reticular Formation* in Volume 1, Chapter 3). As in the case of DA neurons, NE neurons are responsive to changes associated with learning. Whereas DA neurons appear to be responsive to the appetitive and hedonic salience of significant events, NE neurons are responsive to their attention-grabbing aspects (Schultz, 1998). Conditioned reinforcement appears to involve a coordinated process involving both NE and DA circuits, with the former mediating alert and orientation to the bridging stimulus and the latter assessing its appetitive and hedonic significance. In addition to mediating orienting responses and selective attention, NE circuits appear to play an important role in

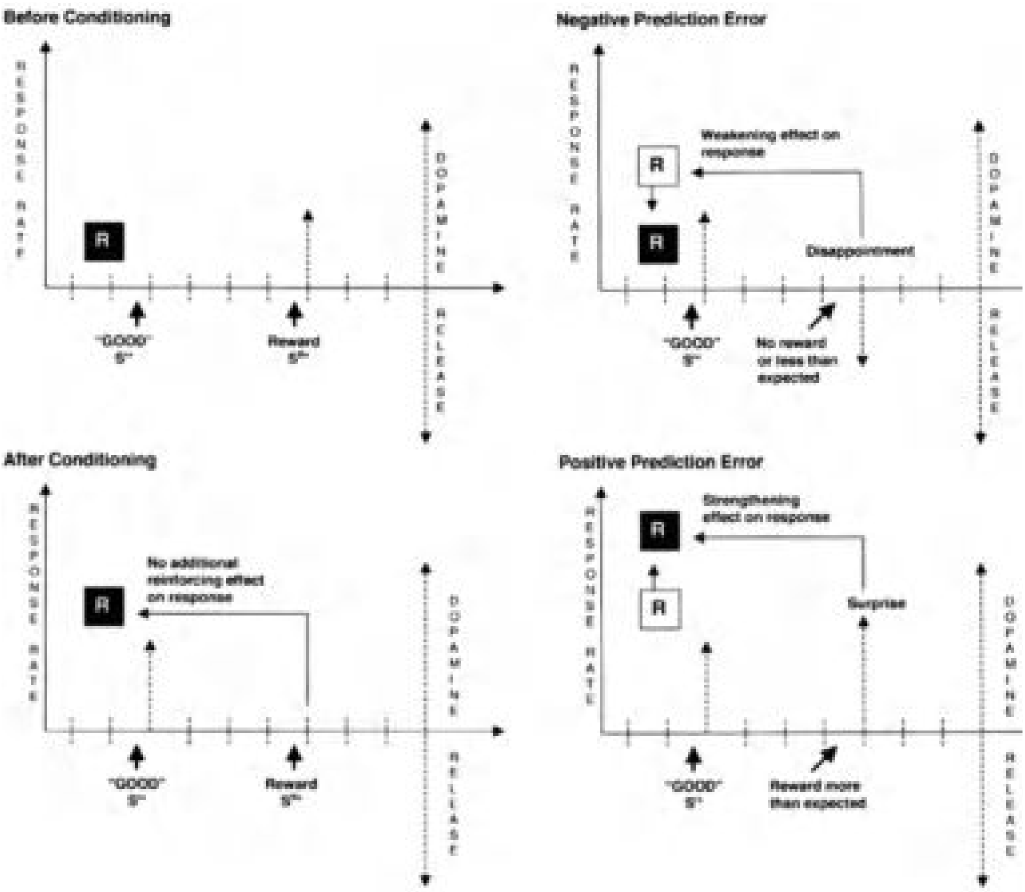

FIG. 1.2. Prior to conditioning, the vocal signal "Good" (S^{R+}) fails to provide conditioned reinforcement, as indicated by the absence of dopamine reward activity. After conditioning, however, dopamine release shifts toward the occurrence of the conditioned reinforcer and away from the predicted reward (S^{R+}). The well-predicted reward loses its capacity to activate the release of dopamine. Without a prediction error, additional learning does not appear to occur.

more flexible scanning activities (Aston-Jones et al., 1999).

Prediction and Control Expectancies

Learning appears to proceed as the result of the acquisition and refinement of prediction-control expectancies, necessitating the postulation of a hypothetical expectancy-comparator mechanism, whereby what a dog expects to occur is compared with what actually occurs (see *Neural Comparator Systems* in Chapter 10). Numerous comparator circuits sensitive to prediction error are distributed throughout the brain, mediating a variety of neural and behavioral adjustments in response to changing moment-to-moment circumstances (Schultz and Dickinson, 2000). These specialized comparator circuits appear to communicate together and orchestrate complex adaptive functions, including the detection of prediction errors conducive to reward and punishment. Prediction-error signals resulting in reward and punishment are produced when what the dog anticipates to occur as the result of an action (control module) and conditioned reinforcement turns out to be better or worse than expected. Such positive and negative prediction errors differentially produce reward or punishment by activating or depressing dopamine activity.

According to the expectancy-comparator model, predictions are processed by a complex series of feedback loops that serve to confirm or disconfirm expectancies, process error signals, calibrate appetitive and emotional establishing operations, and adjust behavioral output to control target events more effectively. In the process of confirming instrumental control expectancies, the detection of prediction discrepancies results in four possible effects:

1. Attractive outcomes that occur earlier than anticipated or are better than expected serve to produce positive prediction errors, surprise, and reward signals.
2. Attractive outcomes that are omitted or turn out to be worse than expected serve to produce negative prediction errors, disappointment, and punitive signals.
3. Aversive outcomes that are omitted or are better (less painful or frightening) than expected serve to produce positive prediction errors, relief, and reward signals.
4. Aversive outcomes that occur sooner than anticipated or are worse (more painful or frightening) than expected serve to produce negative prediction errors, startle, and punitive signals.

The practical implications of these findings are significant. Deliberately arranging reward outcomes to produce positive prediction error serves to make training efforts more efficient and effective, helping to avoid plateaus and enhancing performance reliability and quality (e.g., speed and enthusiasm), even in the presence of highly attractive distractions. However, simply varying rewards randomly is not conducive to positive prediction error and the generation of DA reward signals. Prediction discrepancies and errors can be detected only against a backdrop of an already established pattern of highly predictable outcomes. Consequently, the first step is to provide the dog with a highly predictable and controllable pattern of reinforcement, thereby establishing a standard expectancy against which deviations can be detected and compared. The destructive behavioral effects associated with unpredictable and uncontrollable social interaction may be due in part to a failure to develop a standard against which to judge outcomes and detect prediction discrepancies conducive to reward activation. Typically, variables conducive to prediction error are arranged to occur as trained responses approach or reach plateaus. Plateaus in the training process signal the need for additional reward, and the way to achieve that effect is not by providing bigger and better rewards, but by introducing prediction-error contingencies, that is, vary the size, type, frequency, and timing of the reinforcing outcome. Outcomes can be varied in a variety of ways while training the dog. During recall training, for example, as the dog turns to come in response to its name or a relevant orienting stimulus (e.g., hand clap or lip smooch), the trainer flicks the right hand out to the side with fingers wrapped in a fist around the reward. As the dog touches the closed hand with its nose, the trainer says

"Good" and the reveals the contents. Alternatively, a clicker can be closely paired with the opening of the hand (see *Introductory Lessons*). As the dog learns to come and touch the hand, the concealed reward is varied in different ways. In addition to varying the size and type of reward, the length of time the dog must wait before the hand is opened is also varied from an immediate presentation to a 3-second delay. Another method of varying rewards involves sustained reinforcement. In this case, instead of altering the amount and type of the reward and giving it to the dog all at once, it is given to the dog over a period in a piecemeal fashion. For example, after the dog comes and sits, a treat or two is broken up into a dozen small pieces and fed one piece at a time over the course of 15 to 20 seconds. Sustained-reinforcement techniques can be particularly effective in dogs with attention problems. Rewards are presented in such a way that the dog cannot predict how much food it will receive as a reward or how long it must wait. Mixed into this pattern are other types of food rewards (e.g., kibble, various meats, biscuit pieces, cheese, jerky, cereals, and soft treats). Varying the amount and type of reward appears to maximize the effect of reinforcement, causing dogs to work harder and rendering the learned behavior more resistant to extinction. Because the reward varies in size, type, frequency, and timing of presentation, the dog is alternately affected by surprise and disappointment. When reward (surprise) and punishment (disappointment) are presented in a balanced proportion, a prediction dissonance and control incentive based on hope is produced. Prediction-error contingencies that provide more reward (positive prediction error) than punishment tend to produce prediction-dissonance effects conducive to elation and increased active modal activity, whereas contingencies that limit positive prediction error tend to produce behavioral plateaus and ruts, boredom, and despair. Finally, poorly predicted contingencies that involve uncontrollable aversive stimuli or outcomes producing more punishment (negative prediction error) than reward are prone to produce maladaptive prediction-dissonance effects and neurotic passive modal activity, with increased anxiety and frustration (behavioral stress), depression, and irritability.

A comparator mechanism associated with the septohippocampal system (SHS) appears to respond to prediction discrepancies related to novelty and startle. Prediction-error signals originating in the SHS are believed to activate a neural network mediating startle and behavioral inhibition, causing the animal to "stop, look, and listen, and get ready for action" (Gray, 1991:114) (see *Learning and the Septohippocampal System* in Volume 1, Chapter 3). The momentary pause in activity produced by novelty and startle may be the result of a sensorimotor priority given to unusual or unexpected events. Novelty and startle appear to activate increased emotional and cognitive processing, apparently with the goal of assessing the significance of unusual events and adjusting behavioral output accordingly; that is, novelty and startle are received and interpreted in terms of new information. Consistent with such a information-processing function, attenuated stimuli occurring immediately before the startling event appear to perform an automatic sensorimotor gating function (prepulse inhibition), whereby excessive or insignificant stimuli occurring at the moment of stimulation are barred from cognitive and emotional processing in order to prevent overload and help to ensure that only the most relevant stimuli present in the situation are focused upon (see Koch, 1999). The gating function associated with prepulse inhibition suggests the possibility that subtle signals immediately preceding a startling event may be preferentially associated with startle—a phenomenon confirmed by many common dog-training applications of startle conditioning. In addition to enhancing startle-conditioning effects and learning, an attenuated vocal, auditory, or olfactory signal presented immediately before a startling event appears to reduce the magnitude of the startle response significantly. Interestingly, the absence or lack of prepulse inhibition appears to be a marker associated with a variety of psychiatric disorders (Braff et al., 2001).

Gray (1991) has proposed that behavior is regulated by three focal neural systems: a behavioral approach system (BAS), a behavioral inhibition system (BIS), and a flight-fear system

(FFS). The BAS is activated by stimuli associated with appetitive arousal, reward, and the cessation of punishment, whereas the BIS is activated by unfamiliar stimuli (novelty), startle, and conditioned stimuli associated with aversive events and punishment (loss of reward). The FFS is activated by unconditioned aversive stimulation and nonreward (i.e., loss of safety and comfort) mediating escape behavior and defensive aggression. In addition to mediating rapid and disruptive startle, hesitation, or avoidance in response to startle and novelty, the BIS is activated by conditioned aversive stimuli and biologically prepared fear stimuli, loss of reward (negative prediction errors), or the disconfirmation of control expectancies. The BAS, on the other hand, is activated by conditioned and unconditioned stimuli eliciting appetitive arousal (establishing operations) and by signals of reward and the absence of punishment (positive prediction errors). Whereas the activation of the BIS by novelty/startle or loss of reward promotes increased arousal, scanning and vigilance, hesitation, and waiting, the activation of the BAS via surprise-dependent reward intensifies attention and interest, and promotes fearless seeking, searching, and exploratory activities. The BAS operates under the modulating influence of dopaminergic pathways in close association with the activation of species-typical motor programs. Under the influence of excessive BAS activation and imbalance, a dog may be made more vulnerable to compulsive-impulsive spectrum disorders. The BIS, on the other hand, appears to be under the modulating influences of noradrenergic and serotonergic pathways (anxiety-depression spectrum). Excessive activation of the BIS is associated with anxiety-depression spectrum disorders. The BAS and BIS are the rough neural correlates of active and passive modal activities and strategies.

Instrumental Control Modules and Modal Strategies

According to cynopraxic training theory, control expectancies are closely coordinated with establishing operations and adaptive modal strategies. Establishing operations are under the regulation of classical conditioning and mediate associative and motivational linkages between control expectancies and emotional command systems. Functionally speaking, establishing operations calibrate appetitive and emotional arousal in accordance with predictive information derived from instrumental control efforts. In effect, the establishing operation mediates a precise motivational state that defines in advance the sort of instrumental output needed to obtain gratification, that is, produce outcomes conducive to comfort or safety. Collectively, instrumental control incentives, appetitive and emotional establishing operations, prediction and control expectancies, and instrumental actions are referred to as control expectancy modules (control modules). Control modules, routines (linked modules and skills), and goal-directed projects operate within the context of active and passive modal strategies to form patterns of adaptive behavior. Control modules and adaptive modal strategies are postulated as the basic units of behavioral organization. Modal activities are general classes of motivated behavior consisting of active strategies (exploring, seeking, playing, searching, experimenting) and passive strategies (checking, waiting, hesitating, deferring, delaying, worrying), roughly corresponding to Gray's BAS and BIS. Control modules and routines operate in close association with modal strategies. Positive and negative prediction errors produced by the operation of control modules and routines have a differential activating or depressing influence on behavior and mood, mediating the expression of active and passive modal strategies. The various immediate and cumulative emotional and mood effects associated with positive and negative prediction error are referred to as positive and negative dissonance.

Active modal strategies develop in association with control modules and routines in the process of optimizing control efforts over aversive and attractive events. Active modal strategies organize the performance of control modules and routines into patterns of behavior that increase the likelihood of producing positive prediction errors, that is, set the occasion for surprise, discovery, and reward. Control incentives involving attractive and aversive outcomes entrain control modules and routines into patterns of modal searching, exploring, experimenting, adventure, risk taking, and daring. Active modal strategies are supported by reward (that is, better-than-expected outcomes)

produced in the process of exploiting appetitive resources or controlling dangerous situations. Passive modal strategies are closely associated with the operation of well-established and orderly control modules and routines, representing the conservative, preservative, careful, and risk-avoidant patterns of organized behavior. Passive modal strategies are primarily involved in the detection and avoidance of negative prediction error (disappointment) and punishment.

Passive modal strategies develop in situations where active modal strategies fail (i.e., produce punishment and loss of reward). Under adverse circumstances, punishment may educe incompatible passive modal strategies (e.g., waiting, hesitating, deferring, delaying) aimed at avoiding negative prediction error and punishment. Although passive modal strategies are organized to preserve security (comfort and safety), they do so at a heavy potential cost that may, if performed in excess or to the exclusion of active modal success, ultimately result in progressive disorder and insecurity. Excessive passive modal activity is associated with increased worry and hypervigilance, the gradual loss of responsiveness to reward (dissatisfaction and pessimism), and increasing vulnerability to aversive arousal and emotional tone (anxiety, depression, and irritability). Active modal strategies, on the other hand, tend to pattern control modules and routines toward increasing behavioral variability and output via the search and discovery of positive prediction error (surprise and reward). In contrast to the aversive emotional tone (anxiety and depression) and inhibition of behavioral output associated with passive modal strategies, active modal strategies promote elation, excitement, enthusiasm, and diversification of behavior. However, under situations where active modal strategies operate in relative isolation from the order-enhancing influence of passive modal strategies, various imbalances involving impulsiveness, overactivity, attention deficits, loss of control, and behavioral disorganization may ensue. When functioning together harmoniously and operating under the prediction dissonance of hope, active and passive modal strategies produce a behavioral organization consisting of a balance of order and variability (see *Organizational Order and Variability*). A clarification and elaboration of these various distinctions and their implications for dog behavior therapy and training are provided in Chapter 10.

Establishing Operations

An overarching and paramount psychological need is the optimization of predictive control over the local environment via learning and behavioral adaptation. The attainment of such goals presumes the existence of orderly and stable environmental circumstances. Dogs are motivationally affected by a variety of transient conditioned and unconditioned establishing operations conducive to enhanced prediction and control (see *Antecedent Control: Establishing Operations and Discriminative Stimuli* in Volume 1, Chapter 7). An establishing operation consists of any activity, event, or condition that renders a reward more effective. In addition to enhancing the motivational salience and effectiveness of instrumental rewards, an establishing operation sets the occasion for the occurrence of behaviors previously rewarded under its motivational influence. For example, food deprivation is an appetitive establishing operation that significantly enhances the reward value of food while at the same time encouraging dogs to offer behavior that has been rewarded previously with food. Conversely, activities, events, or conditions that reduce the effectiveness of a reward and decrease the occurrence of responses previously reinforced by it are referred to as abolishing operations (Michael, 2000). For example, satiation has an opposite effect on the value of food as a reward; that is, feeding the dog before training reduces the appetitive value of food and decreases the occurrence of behaviors that have been rewarded with food in the past. Identifying and using establishing and abolishing operations are important aspects of behavior assessment and problem solving (McGill, 1999; Iwata et al., 2000).

At the cognitive-emotional level of organization, establishing operations are postulated as performing the role of coordinating motivational arousal with instrumental behavioral adjustments via a loop of classically conditioned prediction expectancies (see *Adaptation, Prediction Error, and Distress* in Chapter

10). Establishing operations calibrate appetitive and emotional arousal to match behavioral output in terms of ongoing and anticipated situational change. The instrumental control expectancy defines in advance the sort of behavior needed to gratify the motivational state produced by the establishing operation. As such, establishing operations function as interfacing conduits between control expectancies and emotional command systems. Establishing operations are modulated by prediction-error signals coded in the process of confirming or disconfirming control expectancies. Both control expectancies and establishing operations are adjusted and refined in response to reward and punishment signals, thereby enabling dogs to better predict and exploit or avoid the detected discrepancy in the future. Active (e.g., seeking) and passive (e.g., waiting) modal strategies are highly sensitive to the activating and depressing effects of positive and negative prediction errors. Active modal strategies, including social and environmental exploring, searching, experimenting, testing, and so forth are dedicated to the search for positive prediction errors and the avoidance of negative ones. The enhanced order and security provided by instrumental control modules, routines, and patterns are the accumulated results of useful discoveries produced in cooperation with active and passive modal strategies. Modal strategies are not functionally independent of control expectancy modules, but rather depend on prediction errors arising in the process of confirming or disconfirming them. Whereas control modules and routines produce order conducive to survival and security (comfort and safety), active modal strategies promote variability, discovery, and risk taking. Passive modal strategies are likely to occur primarily under conditions of order and where active modal strategies are likely to produce loss of reward or punishment (see *Drive-related Modal Activity and Strategies* in Chapter 10).

Daily activities provide numerous opportunities to exploit establishing operations conducive to increased instrumental output and reward. Using these transient moments of heightened motivation is a central aspect to ICT. For example, going for a walk is usually a highly valued activity for most dogs. Occasions anticipating a walk trigger significant anticipatory arousal, frenetic pacing, jumping up, and barking. The establishing operations associated with getting ready to go for a walk motivationally set the occasion for a variety of undesirable behaviors that are reinforced before a dog is let outside. If, instead of allowing the dog to engage in undesirable behavior at such times, the trainer requires that the dog perform a balanced cycle of tasks before leaving the house, the behaviors involved will undergo significant reinforcement and change over time in association with the opportunity to go for a walk. Another valuable establishing operation occurs as the result of separation. Following a long separation, a dog's interest in social attention and contact is significantly enhanced. The resulting social establishing operation can be used to promote a variety of training objectives. Social rewards can be used effectively at such times to reinforce attention and impulse control, as well as to strengthen the dog's willingness to come when called and other basic exercises. Another everyday opportunity for exploiting motivation conducive to training occurs in association with feeding times. Training that uses food reinforcement is enhanced by taking advantage of appetitive establishing operations associated with the expectation of a pending meal.

Despite the usefulness of social and appetitive establishing operations, the ultimate motivational operation for dog-training purposes is play (see *Modulatory and Unifying Effects of Play* in Chapter 6). Ludic establishing operations are resistant to satiation (abolishing operations) and conducive to the mood-enhancing effects of reward. For example, when catching a flying disk or chasing an out-of-round rubber toy, a tremendous amount of variety occurs in a dog's movements and the effects produced by them. With every chase and catch, deviations from the standard expectancy occur that are conducive to prediction error: air turbulence may cause the disk to turn up or down, float longer than usual or dive rapidly to the ground, or unexpectedly to veer off—all con-

tributing to unusual maneuvers and catches (surprise) and misses (disappointment). The net result of such play is a high level of reward and positive dissonance (elation). Control modules and routines established in the context of play are highly durable and resistant to extinction. When properly carried out, play-rewarded behavior gradually becomes play itself, making the opportunity to perform the behavior its own reward. Play has the ability to educe and shape drive-related behaviors into unique and usable forms with a rapidity that cannot be accomplished by other means of reward. The playful eduction and entrainment of drive-related modal activities is the basis of many practical dog-training activities. Working dogs work to play and play while working.

Diverters and Disrupters

In accordance with the control-incentive theory of reinforcement, attractive and aversive events are only reinforcing to the extent that the dog is actively engaged in efforts to control them (see *Diverters and Disrupters* in Volume 1, Chapter 7). For example, tossing a dog a piece of food while it is straining on the leash in order to play with another dog would not likely strengthen the pulling response, certainly not as much as might occur by letting go of the leash (see the previous discussion regarding the Premack principle). Similarly, throwing a treat to a dog while it is aggressively barking at a passerby will not likely reinforce the barking behavior, but if the person happened to run away in response to the dog's threats, then such territorial behavior might be strongly reinforced. In both cases, the presentation of noncontingent treats may interrupt instrumental behavior by exciting motivational interests irrelevant or incompatible with the rewards being sought by the dog at the moment. If the diverter performs an establishing-operation function, the dog will subsequently exhibit instrumental efforts aimed at controlling the diversionary stimulus. Under the influence of a control incentive, the diversionary stimulus may become a reward capable of performing a reinforcement function. However, even if a control contingency were inadvertently established between the barking behavior and the food item presented as a diverter, the barking response would be gradually stripped of its defensive significance via the classical conditioning effects of food reinforcement. Now, although a passerby might function as a discriminative stimulus for barking to get food rewards, the barking behavior would be of a very different motivational nature than aggressive barking and more readily controlled via a contingency of reinforcement now under the trainer's control. Disrupters are typically startle-producing stimuli that serve to interrupt behavior momentarily but without necessarily mediating a punitive effect. For example, in the case of a barking dog that ignores food at such times, a burst of compressed air might momentarily interrupt or briefly stop defensive barking. The brief hissing sound might immediately stop the behavior, but the effect may not last for long or significantly alter the future occurrence of the barking response. However, if the hissing startle is repeatedly presented under similar circumstances when the dog barks and is immediately preceded by some avoidance signal (e.g., "Quiet"), the dog may gradually learn to control the occurrence of the aversive event by not barking while in the predictive context or by stopping when the vocal avoidance signal is delivered. A preferable approach, though, is to follow the disrupter event with reward-based training efforts aimed at shaping responses incompatible with defensive barking (e.g., sitting or standing quietly for food and petting in the presence of the target). The combination of interruption and reward-based training can strongly enhance control efforts.

Directive Prompts and Blocking

Directive prompts and reprimands are the most common procedures used to enhance attention and impulse control. Although directive procedures can be highly effective and efficient, they can also produce significant fallout when used improperly or excessively (see *Coercive Compulsion and Conflict*

in Volume 1, Chapter 8). Attention and directive prompts serve the purpose of limiting behavior that disrupts or interferes with reward-based training objectives, especially behavior occurring under the influence of competing distractions, that is, extraneous establishing operations and sources of reward not under a trainer's control. In addition to capturing the dog's attention and enhancing impulse control, an obvious advantage of vocal and directive prompts in training is the ease and immediacy with which a highly motivational state (establishing operation) can be produced and exploited. Directive prompts perform two functions at once: they block or inhibit undesirable behavior (compel abstention) while at the same time causing the dog to produce more acceptable alternative behavior (inducing action). Such procedures and techniques are particularly useful and beneficial for the control of harmful or potentially dangerous activities. The paradigm's simplicity and power to establish immediate motivational change and readiness to work has made the correct-and-praise method of training very popular over the years—a method that remains a standard and integral aspect of many fields of practical dog training, especially those activities requiring a high degree of control and performance reliability. The firm and unshakeable reality of dog training is that some amount of compulsion is unavoidable.

Distractions: Extraneous Sources of Reward

Since no natural environment is completely free of distractions, a significant portion of training time is dedicated to gaining control over behavior operating under the influence of extraneous rewards. In a certain sense, distractions represent a valuable source of potential rewards not yet under a trainer's control. Staging training activities so that distractions can be made available to the dog on a contingent basis represents a powerful means to reduce the disruptive effects of distractions as well as serving to advance training objectives. The combination of response-blocking and directive techniques within the context of reward-based training activities facilitates the process of harnessing extraneous rewards to constructive goals. For example, preventing a dog from playing or chasing after another dog can be followed by an opportunity to engage safely in the activity, so long as it first waits and defers to the trainer's control prerogatives. Exploratory distractions of various kinds can be provided on a contingent basis provided that the dog periodically turns its attention to the trainer on signal, comes when called, and so forth. Since naturally occurring sources of reward are difficult to control and potentially dangerous to give on a contingent basis, motivationally equivalent activities may need to be identified and given to the dog instead. An alternative for dogs that enjoy chasing animals is the provision of tug-and-retrieve games, especially ball and flying-disk play. Dogs that engage in excessive exploratory behavior can be encouraged to play various hide-and-seek games in which toys are hidden for them to find.

Some extraneous sources of reward cannot be reliably controlled through the aforementioned procedures but may simply need to be inhibited and replaced with an alternative behavior. Directive training efforts are carried out to proof the dog's compliance under a wide variety of circumstances and distractions. Such training codes distractive stimuli into inhibitory signals, causing the dog to wait or stop when exposed to them rather than stimulating increased arousal and loss of control. Inhibitory training is recommended in the case of persistent behaviors posing significant potential harm to the dog or others. For example, dogs that chase after cars, bicyclists, joggers, and so forth may simply need to learn to avoid such activities by the application of appropriate commands, reprimands, and corrections. As the result of well-timed and appropriately impressive corrections, such dogs gradually become more responsive to commands and reprimands in the face of distracting influences. Gradually, by means of associative learning, distractions become conditioned into avoidance or inhibitory signals rather stimuli triggering arousal and chase behavior. For example, many dogs exhibiting the unacceptable habit of chasing cats quickly learn, after the delivery of a few directive leash prompts or electrical corrections, that

lunging after a fleeing cat only results in discomfort and nonreward—not the attainment of the anticipated joys of the chase. As a result, the dog learns to approach cats with improved self-control, first hesitating and then gradually learning to avoid chasing them altogether, and finally learning to ignore them or to expect food rewards in their presence as the result of concurrent reward-based attention and sit-stay training efforts. The overall effect is to improve the dog's attention to the trainer's instruction whenever a cat happens to be nearby.

Least Intrusive and Minimally Aversive

Correction procedures should not be used lightly or haphazardly. The rule of thumb is to select the least aversive and intrusive procedure that is reasonably expected to succeed. According to the least intrusive and minimally aversive (LIMA) model, aversives are ranked in terms of their relative severity and intrusiveness, requiring that the trainer apply a less aversive technique before advancing to a more aversive one (see *Compliance* in Volume 2, Chapter 2). Adhering to this model and selection process ensures that the least necessary and sufficient aversive procedure is used to produce the intended behavioral objective. In addition to minimizing the potential for producing pain and discomfort, correction procedures should be governed by a principle of minimal intrusiveness. Training procedures should intrude minimally on the human-dog bond and avoid adversely affecting the dog's quality of life. Overly constrictive restraint and confinement techniques should be avoided in favor of techniques that most rapidly and humanely achieve training objectives without causing undue distress or discomfort to the dog.

PART 2: TOOLS AND TECHNIQUES

Training Tools

The equipment used in dog and puppy training is fitted with a concern for the dog's age, size, temperament, training history, and specific needs. A wide range of products of varying quality and price are available. Training equipment should be of the best quality, remembering that cheap equipment is most likely to fail when it is needed most. All training tools have advantages and disadvantages that need to be considered carefully, and each requires a degree of expertise for proper use. Although some rather vitriolic and unproductive hyperbole bubbles up now and then against the use of various training collars, most experienced and competent trainers agree that such tools have a functional and humane place in dog training. Any standard training tool can be used abusively and cause injury, but there is nothing inherently cruel about such tools (see Delta Society, 2001). Although neck injury can result from the improper use of a slip or halter collar, I have personally never witnessed or know of a single verified case in which a dog sustained serious cervical injury as the result of a properly applied leash correction, even involving corrections that have been applied very forcefully. Some dogs (e.g., the toy poodle and Yorkshire terrier) appear to be predisposed to tracheal problems and should be trained on harnesses. If in doubt about the suitability of a specific collar for a particular dog, consult a veterinarian for advice.

Flat-strap and Martingale Collars

For many dogs, commercially available flat-strap and buckle or so-called martingale collars are sufficient for most training purposes. The flat collar is tightened just snugly enough to prevent it from slipping over the dog's head. When properly fitted, the martingale collar has the advantage of a slack fit with little risk of the dog backing out of it. Puppies under 5 months of age are typically trained with a strap collar alone or a fixed-action halter. In the case of strong puppies and dogs, a buckle-type fastener is preferred over a plastic snap-on one.

Limited-slip Collars

A highly effective limited-slip collar can be made from a single length of nylon webbing (Figure 1.3). The primary advantage of the limited-slip collar is adjustability, both in terms of the range of slip action and the pressure

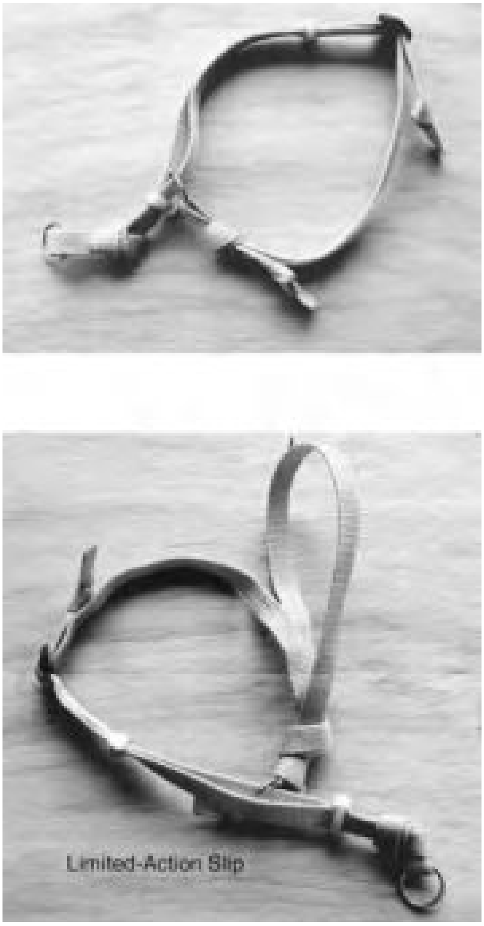

FIG. 1.3. Limited-slip collar (top) and limited-slip/halter combination collar (bottom) provide excellent control and adjustability.

applied to a dog's neck. The limited-slip collar features two slides that are used to make these adjustments. As in the case of full-action slip collars, the limited-action collar is placed around a dog's neck so that it forms a "p for perfect" (frontal view). Another way of making sure that the slip collar is on properly is to observe how the collar closes. When pulling the live ring (the one hooked to the leash), the collar should close dragging the dead ring clockwise around the dog's neck.

Conventional Slip Collars

Many trainers prefer using a nylon-slip or chain-slip collar—a collar that remains especially popular among working-dog trainers. The chain-slip or check collar consists of a chain with two rings, the live ring and the dead ring. The leash is attached to the live ring, causing the dead ring to travel clockwise around the dog's neck as it applies momentary pressure. The term *choke collar* is a misnomer that may have contributed to a significant misunderstanding about the use of such collars, as evident among inexperienced dog owners who purchase them to control pulling dogs. Many people use these collars under the false assumption that they work to stop pulling behavior by choking the dog. Consequently, under the belief that the choking effect will eventually discourage pulling, they allow the dog to pull continuously during walks. This belief is not only wrong with regard to the reduction of pulling behavior, but such control by choking may also produce significant physiological distress and harm (see *Walking on a Slack Leash*). The size of the chain-slip collar is estimated by measuring the widest part of the dog's head. A chain-slip collar can be made safer by placing a key ring through the chain to block the collar from closing too tightly around the dog's neck, thus limiting the amount of compression to the neck that the collar can deliver (Figure 1.4). In addition, a split ring can be attached to the chain to prevent it from sliding through the dead ring, thereby helping to keep the collar in place on the dog's neck. The training slip collar requires significant skill to be used properly and safely.

Prong Collars

The prong collar features a high degree of adjustability by way of removable prong links that are positioned to press into a dog's neck as the leash is pulled back (see Figure 1.4). A chain with two opposing rings (the center ring and swivel ring) closes the collar with an action similar to that of the martingale collar. The prong collar can be converted into a martingale collar by turning it around so that the prongs face away from the dog's skin. The leash is attached to the swivel ring. The center ring on the reciprocating chain slides from side to side. The side-to-side action of the central ring serves to direct prong pressure

FIG. 1.4. Limited-slip chain (chain-slip) collar (top) and micro and small prong collars (bottom). The chain-slip collar can be modified to yield enhanced adjustability and safe control over the slip action.

differentially to different parts of the dog's neck. When pulled straight back, the chain causes the prong collar to close evenly around the dog's neck. When the leash is pulled toward the right, the center ring shifts position and catches on prong links that direct most of the leash pressure to the left side of the dog's neck, causing it to move to the right in a highly controlled way. These actions and effects are useful for shaping and polishing precision heeling. The proper use of the prong collar as a shaping and polishing tool requires significant instruction, but with respect to basic control uses novice trainers can rapidly master the prong collar. It is frequently used to train high-spirited working dogs.

Halter Collars

A variety of halter collars are currently on the market. Most of these can be traced to an original concept and design fashioned by Alice DeGroot and patented in 1984 (Figure 1.5). DeGroot's K-9 Kumalong design offers significant head and muzzle control while at the same time allowing the dog to open its mouth fully. The basic logical and mechanical principle of DeGroot's collar is that "where the dog's head is led, the body is sure to follow." (DeGroot, 1985:30). In addition to improved head control, the muzzle action of the collar provides a source of negative reinforcement and jaw control. Whenever a dog

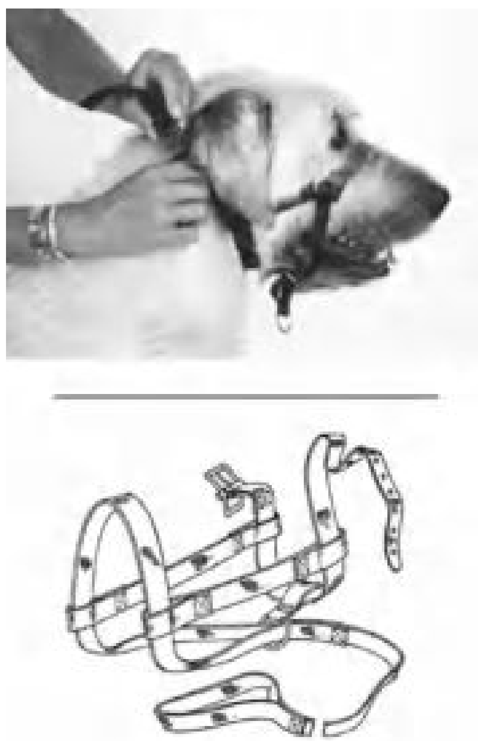

FIG. 1.5. K-9 Kumalong.

pulls back against the leash, the clamping action of the muzzle loop closes the dog's mouth, an effect that is immediately reversed when the dog stops pulling. DeGroot suggests that part of the halter's effectiveness may stem from ethological origins, in particular, from the way in which the mother disciplines or reorients her puppy by manipulating its muzzle. She argues that the Kumalong muzzle loop provides "surrogate maternal control" (31), an effect that adult and dominant dogs may resent, causing them to resist halter control fiercely when they are first exposed to it. Although some dogs may become momentarily reactive to halter restraint, others appear to become progressively relaxed and calmed as the result of it, an effect that DeGroot claims is especially prominent in hyperactive, nervous, or timid dogs. She speculates that the tranquilizing effect of halter control may be due to endorphin release, perhaps involving a mechanism similar to that attributed to the tranquilizing effect of acupuncture treatment.

With the advent of muzzling-type halters, the slip action of the traditional training collar shifted from around the dog's neck to a more vulnerable point around its muzzle. The muzzle-controlling loop effortlessly twists and turns a dog's head when it pulls, while forcefully pinning the dog's mouth shut if it attempts to struggle or back out of the collar. Of course, the capability of such collars to control the head and exert a forceful muzzling action is a desirable innovation in the case of aggressive dogs, providing trainers with increased control and safety over such situations than afforded by conventional collars. A subsequent halter design marketed under the trade names Promise and Gentle Leader was patented in 1986 by R. K. Alexander with two co-inventors, as a combination collar and muzzle training aid. Over the years, Anderson has been an enthusiastic proponent of halter training in the context of veterinary behavior management and therapy. The collar-muzzle combination provides secure control over a dog's head movements, produces a robust muzzle-clamping action, and features a fixed-muzzle capability. Releasing and moving up a plastic adjusting slide located on the muzzle loop and resetting it at a point that prevents the dog from opening its mouth produces a partial muzzle effect. Although a muzzle set in this way prevents wide-mouthed bites, dogs can still manage to pinch with their incisors. Clamping the muzzle loop down farther to completely prevent pinching bites is not recommended, since it results in significant discomfort and distress to dogs. In such cases, or in cases involving a serious risk of attack, a mesh-sleeve or basket-type muzzle should be used instead of a muzzle-type halter.

Most dogs exposed to halter collars exhibit varying amounts of struggle and distress before finally accepting the restraint (Haug et al., 2002). After several brief sessions of introductory training with treats and patient encouragement, the vast majority of dogs calm down and learn to accept or at least tolerate the collar. The odor of orange oil (2 or 3 drops) rubbed on the hands or presented from a scented squeaker bulb can exert a potent calming effect over persistent reactivity to halter restraint when presented to the dog to sniff. The subsequent presentation of the odor of orange appears to work as both a calmative and a positive reinforcer to maintain more relaxed behavior. However, some dogs simply will not accept such restraint and react with persistent and vigorous protest and present an appearance of significant distress. Aggressive dogs (especially experienced biters) that resent the halter represent a significant risk to trainers or owners when they attempt to put the halter over the dog's muzzle.

Although one would expect to find significant differences in the biological stress exhibited by dogs wearing flat collars versus halters, a study performed at the University of Minnesota found no significant stress-related physiological differences between the Gentle Leader and a flat-strap collar (Ogburn et al., 1998). Head collars should be used with great care, since they work by twisting a dog's head and neck. Excessively hard corrections or surprise lunges by the dog could result in cervical strain or injury, especially in dogs predisposed to such injury, but to my knowledge no confirmed injuries of this kind have been reported. Halters can produce friction sores on the top of the muzzle, but careful fitting and proper use of such collars prevent most of these problems. In the case of

adult aggressive dogs, halters should be used in combination with an oversized slip collar that is sufficiently long not to interfere with the clamping action of the halter. The backup collar prevents dogs from breaking free during unexpected episodes of intense struggle or when the halter might accidentally come off or fail in some unforeseen way. Alternatively, a backup collar and halter can be fastened to the same leash by hooking a small carabiner through the handle of the leash and attaching it to the collar. The leash forms a closed loop between the collar and halter and is held with both hands, the left hand controlling the collar and the right hand controlling the halter.

Another closed-loop arrangement uses a hip-hitch (see *Hip-hitch*) in combination with a flat strap or limited-slip collar and halter (Figure 1.6). A leash fitted with a small carabiner hooked to the handle of the leash is used. Alternatively, a service leash with bolt snaps at both ends can be used. The carabiner is attached to a strap or limited-slip collar, and the other end of the leash is hooked to the halter, functioning as a control lead. The arrangement provides a closed loop in which forceful pulling is blocked with the hip-hitch, while the halter is used to guide the dog rather than hold it back. This arrangement appears to be safer and more acceptable to many dogs, especially those reactive to halter control. The combination also appears to facilitate active training rather than simply controlling the dog via passive halter restraint. The undesirable clamping action produced by the conventional halter can be eliminated by the arrangement, unless the trainer wishes to produce such additional restraint with the control lead. The use of a hip-hitch and collar in combination with the halter makes the introduction of halter control less evocative and stressful. Instead of functioning as a tool to passively control pulling by forcefully twisting a dog's head, the combined hip-hitch, collar, and halter arrangement allows the halter to be used in a much more gentle way. The arrangement makes fading of halter control easier as more appropriate walking behavior is shaped under the control of the strap or limited-slip collar. Finally, a major advantage of the hip-hitch is that it frees the trainer's hands to present various hand signals, bridges, and rewards, while minimizing the risk that the trainer might accidentally lose control of the leash.

Fixed-action Halter Collars

Although the muzzle-clamping action of most halter collars is highly effective and useful, for most basic training purposes a fixed-action halter is adequate when the added control of a halter is needed. The fixed-action halter has two significant advan-

FIG. 1.6. Closed-loop arrangement with flat collar and fixed-action halter.

tages: snug fit and comfort. The nonclamping muzzle loop ensures that pressure will be appropriately delivered to the back of a dog's head when it pulls back, rather than unnecessarily clamping down on its nose. When the dog pulls ahead, the neck and muzzle loops effectively serve to turn the dog's head, but without putting any unnecessary pressure or rubbing on the dog's muzzle. Fixed-action halter collars provide an excellent transitional means to control excessive pulling in puppies and adult dogs alike. The muzzle loop is formed by tying a figure-of-eight loop or simple overhand loop into an 8-foot length of nylon webbing, leaving a short end to form a neck loop and the remaining long end to make a leash and handle (Figure 1.7). The short end forms the neck loop by slipping it through the muzzle-loop knot and then tying it off to the leash

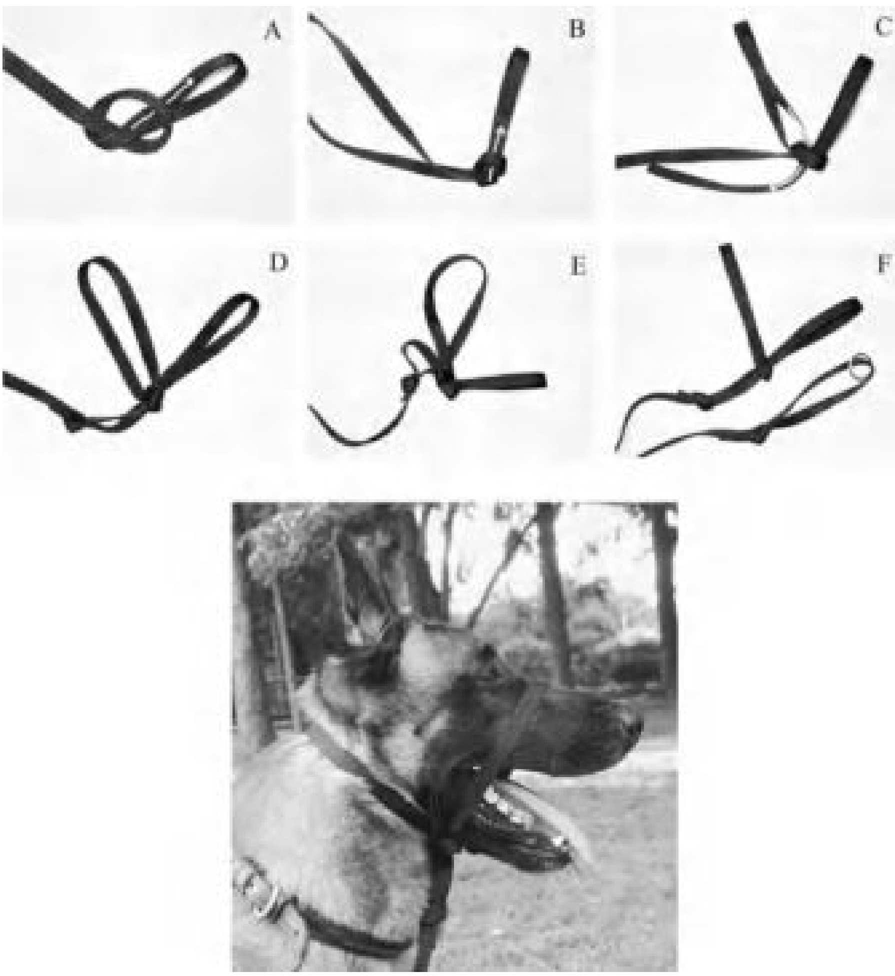

FIG. 1.7. Fixed-action halter. (A) The muzzle loop uses either a figure-of-eight or an overhand loop knot. (B) A finished muzzle-loop knot. (C) The neck loop is formed by slipping the short end through the muzzle-loop knot. (D) A finished halter with the adjusting knot binding the neck loop to the leash. (E) A fixed-action halter is opened by sliding the neck loop through the muzzle-loop knot. (F) A fixed-action halter with handle measured and ready for use as a muzzle-clamping halter.

end approximately 4 to 8 inches below the knot, depending on the size of the dog's neck and head. When fully pulled out, the neck loop should fit snugly, thus preventing the dog from backing out of it, but it should not press uncomfortably around the dog's neck. Once tied off to the leash, the neck loop can be opened by pulling it back through the muzzle-loop knot, thereby expanding it so that the neck loop can get over the dog's head. Before it is closed again, the collar loop is situated just behind the dog's head, and the muzzle loop is placed over its nose. To close the neck loop and secure the muzzle loop in place, the left hand grips the muzzle-loop knot while the right hand pulls the neck-loop knot back, thereby causing the neck loop to tighten and the muzzle loop to move back into place on the dog's nose. The fixed-action halter and leash are continuous with a handle tied into the end of the leash.

In addition to fixed-action halters, a limited-slip/halter combination collar is often used in training (see Figure 1.3). The halter/limited-slip collar combines the advantages of both the halter and slip-action collar, while minimizing some of the disadvantages of conventional slip and muzzling-type halter collars. By distributing force between the limited-slip collar and the muzzle loop, the halter/limited-slip collar provides enhanced head control without excessive clamping or twisting actions. Excessive neck twisting is prevented by the automatic transfer of force from the muzzle loop to the limited-action slip collar. The relative amount of force directed to the neck or muzzle is adjusted by moving the slip-limiting slide on the collar. The flat collar, the limited-slip collar, the fixed-action halter collar, and the halter/limited-slip collar combination are the primary collars used in cynopraxic training.

Fixed-action and Slip-action Harnesses

In cases involving dogs with a propensity for tracheal problems or a veterinary diagnosis counterindicating the use of a collar around the dog's neck, a harness can be a useful alternative. Various designs are available, and proper fitting is critical to prevent the dog from getting out of the harness. Full and half-slip harnesses can be easily made with nylon webbing.

Leash and Long Line

The best training leashes are made of harness leather with a brass bolt-swivel snap braided into the end of the leash. However, a well-stitched nylon or cotton-web leash is also acceptable, especially for puppy training. For most purposes, the leash should be about 6 feet long with a weight and width determined by the training needs, the collar, and the size of the dog. A light leash is preferred for use with a halter. The long line is a 30- to 50-foot length of cotton webbing fitted with a bolt-swivel snap or a one-quarter to five-sixteenth-inch braided white nylon rope that is tied off with a limited-slip collar and knotted handle (Figure 1.8). The white rope long line is preferred for visibility and stretch, whereas the primary advantage of cotton webbing is the absence of stretch when it is pulled taut. The long line requires careful and attentive handling if one is to avoid severe friction burns and other potential injuries resulting from the abrupt force generated by it. Long-line training should be performed in well-controlled surroundings without playing children or dogs nearby, and all observers in the situation should be

FIG. 1.8. Long-line with limited-slip collar tied with a series of overhand knots.

warned of the potential risks and dangers associated with long-line training. Observers are instructed to stay out of way and how to remain on the outside of the line. The trainer should always wear pants and appropriate shoes when working a dog on a long line. Grabbing a long line with bare hands is risky and should be generally avoided. Instead of grabbing it, the trainer should tamp or stamp on the long line to control the dog. If the long line must be handled with the hands, light leather gloves can be used to prevent friction burns. Gloves are generally a mixed blessing, however, since the safety afforded by them is achieved at the cost of losing a sensitive feel for the line. Also, the added security of gloves may cause inexperienced trainers to use the long line without proper respect, perhaps increasing the risk of other more serious injuries (e.g., fingers getting caught and broken). When holding the long line, it should be kept organized in neat folds and carefully managed to prevent it from becoming wrapped around the dog's feet, legs, or body. The long line is carefully folded at the end of training sessions. Before using the long line to control highly motivated behavior, the trainer should first become skillful with it in less demanding situations (e.g., playing ball) and acquire an appreciation for its safe use. Temporary overhand loops can be tied at various points along the line to hook into with the leash, thereby providing the trainer with a secure source of backup control if it is not possible to step on the line.

Hip-hitch

A useful tool for controlling pulling excesses is the hip-hitch and control lead. The simplest hip-hitch method consists of tying a 12- to 20-inch loop in the leash and hooking it to a carabiner held in place at the left hip by a belt. The remaining leash and handle, referred to as the control lead, is used to guide and fine tune control. The hip-hitch requires skill, coordination, and careful attention to various precautions, especially when working with large dogs (see *Controlled-leash Walking and Hip-hitch*).

Miscellaneous Items

Other items of equipment include a carpenter's apron or small treat pouch, a tennis ball with a handle, and treats (Figure 1.9). The most effective commercial dog treats are usually moist and possess a strong odor. Microwaved turkey or chicken hot dogs can make an attractive food reward. The treats are prepared by finely cutting a hot dog into pennywide slices. The pieces are spread out evenly on a paper towel or plate and cooked in a microwave for 2 to 3 minutes or until leathery to touch but not dry. Hot-dog treats are used in small pieces torn from the microwaved slices. Each slice can produce between 3 to 10 rewards, depending on the size of the dog. Chicken or turkey lunchmeat can be partially dried in the microwave and used in a similar way. Small biscuits, cheerios, cornflakes, popcorn, and so forth can be mixed in with hot-dog treats or be coated with the powder produced by microwaving hot dogs until they are dry and then crushing them. Another possibility is to mix some of the dog's kibble with a small amount of finely grated Romano or Parmesan cheese. Crated hard cheese can be sprinkled lightly on cheerios or similar treats and microwaved to give them additional value as food rewards. A tool of considerable usefulness in dog training is the shaker can, which

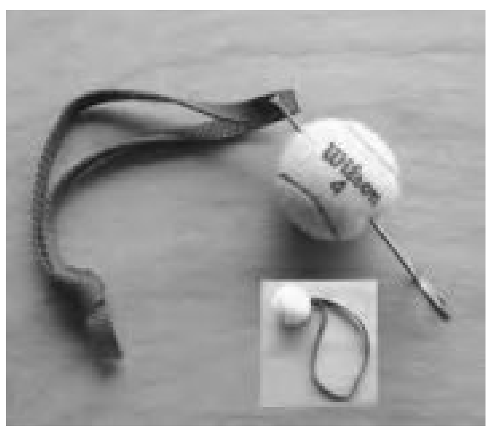

FIG. 1.9. Tennis balls used in training should be equipped with a handle.

is made from an aluminum soda can that has been rinsed and allowed to dry. Usually, two cans are made: one containing seven pennies and the other 30. Turning the finger tab around so that it covers the opening helps to block the pennies from falling out but without muffling the sound, as occurs when tape is used to close the can. Another disrupter-type device that can be very useful is the modified carbon-dioxide pump, which delivers a highly effective hissing sound for getting the dog's attention without producing pain or sensory discomfort. The modified carbon-dioxide pump can be used to deliver conditioned and unconditioned odors, giving it additional usefulness in a variety of applications.

Bridges, Markers, and Flags

During the 1960s, Leon Whitney (1961 and 1963), a veterinarian, breeder, and pioneering dog trainer, first introduced clicker training to the dog-training community. The method of shaping instrumental behavior with a clicker, first described by Skinner (1951) and more recently popularized by Pryor (1985), uses the sound of a clicker that has been repeatedly paired with food to bridge successive approximations of some target behavior with a contingent, but not immediately available, food reward. Unfortunately, clicker training was largely overshadowed by other prevailing techniques that remained relatively dominant in the field until recently. Over the past decade, however, many applied dog behaviorists and trainers have rediscovered the value of the clicker and the technique of shaping. Of course, any distinctive sound (e.g., a click, squeak, or trill) can be used as a bridging signal. Although valuable and effective for purposes of conditioned reinforcement, clickers and other mechanical markers and bridging stimuli have two inherent practical drawbacks: (1) they can be unwieldy for the average dog owner to use, and (2) they are not always immediately at hand when needed. With instruction and practice, most owners can learn how to use a clicker effectively, but such devices should be not be used with the intent to replace conditioned vocal bridges (e.g., "Good"). The squeaker and clicker are especially useful in situations requiring precisely timed conditioned reinforcement (e.g., attention training and shaping procedures) or repeated bridging (e.g., controlled-walking or heeling patterns). In addition, the clicker and squeaker can play a valuable role in the treatment of behavior problems. The clicker provides a discrete and salient stimulus that may help to obviate adverse emotional cues projected unawares in vocal signals. In the case of fearful dogs that are startled by the sharp click sound, a recording of the clicker can be made and delivered with an inexpensive digital recorder (Figure 1.10). The reduced volume of the recorded click sound is less likely to produce a startle response. A major advantage of the clicker and other mechanical bridge signals is that their effect can be conditioned and easily transferred from one person to another without losing potency.

The relative neutrality and clarity of the hiss, beep, click, or squeak can be highly effective for diverting the dog's attention or bridging orienting and attending behavior with reinforcement. Squeakers possess an added potential use obtained by putting an odor inside of them and dispensing it with or without the squeak sound. When dispensed at close quarters (e.g., as the dog sniffs the hand), the odor is released a split second before the squeak sound is generated. The

FIG. 1.10. Different clickers that produce varying levels of sound. The box clicker is equipped with a squeaker element that can be used in combination with the clicker during attention training.

odor can be deliberately arranged to precede the squeak by gently "pulsing" the squeaker bulb, so that the odor is dispensed but without the squeaker sound. Pulsing gives the odor time to reach the dog before the squeaker sound is produced, together with the delivery of a stronger odor stimulus as the squeaker bulb is more firmly squeezed. As the result of repeated pairings of the odor or the odor-squeak combination with food, taction, and other sources of reward, the odor and squeak gradually acquire unique conditioned properties that can be used in a variety of creative ways to modulate reactive thresholds and control attention. In addition to producing a distinctive sound, the squeak, unlike the click, can be varied in various ways, depending on the pattern of squeaking sounds produced or the force used to deliver them, thereby preventing habituation and enhancing its ability to grab the dog's attention. Gently pressing a small amount of air out produces a weak squeak sound, whereas forcefully pressing a full bulb of air through the squeaker valve produces a much louder and more impressive sound. In many cases, the squeaker has already undergone significant conditioning as an auditory stimulus in the context of playing with squeaker toys. Finally, the squeak sound is rapidly conditioned as a bridge or orienting signal, suggesting the possibility that it may be biologically prepared for forming associations with appetitive (seeking) or social activity. Small animals in distress often squeak in a similar way, perhaps helping to explain the apparent preferential and rapid association that can be made between the sound of the squeaker, conditioned odor, and food. Similarly, the squeaker and smooch sound (a powerful orienting stimulus) may be innately attractive and reinforcing. Ryon (1977), for example, found that a captive wolf mother called her 3-week-old pups out of the den interior to its entrance by squeaking.

Normally, dogs are first taught vocal bridging signals (e.g., "Good," "Yes," "That's it," and "Wow"), reward-delay or nonreward markers (e.g., "No," "Phooey," "Wrong," "Eh, eh," "Ack," and "Nah"), and flags (various hand and bodily movements used to momentarily direct a dog's behavior), with the goal of improving the owner's vocal control and other communication efforts. Unlike mechanical bridges or markers, voice and hand signals are charged with human emotional expressiveness—content and meaning that provide significant and valuable secondary bonding and socialization effects. Expressive affectionate talk and gestures help the trainer to transact and connect with the dog via an emotionally activated conduit of empathetic appreciation. The mélange of gross and subtle emotional expressions associated with human approval and disappointment, together with variations of touch (ranging from the gentle stroke to the abrupt shove), all contribute to a dog's fullest socialization and development as a companion. In sum, socially significant and emotionally charged consequences facilitate a profound level of mutual awareness, exchange, and bonding between people and dogs. Optimal training incorporates the broadest possible spectrum of motivational incentives and behavioral potentials of a dog.

Mechanical reinforcers and training techniques tend to promote a push-button attitude toward a dog's behavior and its modification. Although mechanistic precision and efficiency are valuable for attaining certain practical training objectives, excessively technical means may inadvertently interfere with the bond-enhancing goals of cynopraxic training. Both the clicker and other precise mechanical means (e.g., the remote electronic collar) are powerful and effective tools with which to control dog behavior. The effectiveness of these devices has caused them to become increasingly popular among trainers and the dog-owning public, with one company marketing a product that incorporates both a click feature for delivering conditioned reinforcement and an electrical stimulus for delivering negative reinforcement and punishment. With regard to the goals of cynopraxic training, the mixture of expressive voice, gesture, touch, and play are preferred to mechanical bridging stimuli or remote stimulation that target a narrow range of motivational systems. However, the clicker's simplicity and clarity provide a significant advantage for some training activities, such as walking a dog on a slack leash, shaping attention and orienting behavior, and recall—all can benefit from the

immediacy and consistency of mechanical bridging stimuli.

The Training Session

A training session usually consists of a series of repeated trials that are performed with some goal or training objective in mind. Training trials consist of antecedent and consequent events or conditions that are arranged by the trainer to enhance predictive control over a target segment (module) or sequence (routine) of dog behavior. Trials are separated by intertrial periods, usually consisting of less controlled and more natural modal activity and interaction between the trainer and the dog. Many trials are initiated by calling for the dog's attention, whereas releasing the dog with an "OK" and clap often marks the beginning of intertrial periods. Within the context of a training session, trials and intertrial periods are organized into lessons and goal-oriented projects. The practice of modules and routines in conformity with the goals of the project is referred to as an exercise. Projects give structure and purpose to the training session and help to integrate and pattern modules and routines around active and passive modal strategies. Within the context of the training session, special modal outcomes (play and time-out) are arranged to mediate modal integration via sustained surprise and elation (active modal strategy) and disappointment and de-arousal (passive modal strategy). Training sessions organize trials, lessons and exercises (modules and routines), and projects in accordance with the objectives of the training program (e.g., solving a behavior problem). Training activities and procedures are typically introduced and broken down into a series of discrete steps, exercises, and projects (training plan) that are practiced by the owner between sessions. Finally, training activities are performed in accordance with cynopraxic goals and vision.

The steps making up the training plan are organized so that preliminary work prepares the way for the dog to learn what follows next more easily and efficiently, moving from simple modules to progressively more complex routines and skills. Ideally, the training process should proceed with minimal error and tension, becoming a source of fun and mutual reward for both the trainer and the dog. In addition to vocal affection, petting, and food rewards, play activities of various kinds are used to activate control incentives and to reward trained behavior. A brief period of ball play is often used to initiate practice sessions. The ball is also presented periodically during the session as a surprise to enhance interest and to associatively link the trained modules and routines with play. Tug and ball play should also conclude the session to further associate trained behaviors with play, thereby gradually integrating trained behavior with modal play. The session period varies according to the dog, its age, the lesson, and other considerations (e.g., health and temperament). Puppies can benefit from very brief sessions consisting of as little 3 to 8 minutes, but can happily perform and enjoy much longer sessions, provided that the process is reward dense, affectionate, and playful. The average training session for an adult dog is around 20 minutes, including 5 to 10 minutes dedicated to play and agility activities, such as jumping over poles, hoops, and hurdles, and running through weave poles. Longer or briefer sessions are also used depending on training objectives. Training sessions can be scheduled two or three times a day. In addition to training activities performed in the context of structured sessions, a strong emphasis is placed on integrating training activities into everyday activities via ICT.

Play Training

Basic training constrains and focuses natural learning capacities and incentives to obtain behavioral objectives that are often unnatural and occasionally unpleasant or annoying for a dog to perform. Some learning occurs rapidly, and may even be fun for the dog, because it takes advantage of innately prepared associations and drives. Behaviors occurring naturally in the process of play are most easily trained and brought under the control of ludic incentives. Teaching a dog to fetch a ball, for example, is highly prepared and easily learned by most dogs. For many dogs, the opportunity to play ball is hedonically far

more valuable than getting a delicious food reward. Because such dogs love playing ball, the activity can be exchanged for the performance of other behaviors that a dog may not find as enjoyable; that is, ball play can be used as a potent incentive and source of reward. As a result, trained modules and routines can be gradually patterned into modal play activities—a procedure that is widely used in the training of working dogs, making necessary skills more enjoyable for them to learn and perform as the work becomes associatively integrated with play and its performance becomes its own incentive and source of enjoyment (see *Training and Play*).

Every dog should learn to play ball. Older dogs that have not been exposed to play at an early age may not show much interest in the activity, but many can be motivated with patient encouragement and playful stimulation. To increase interest, the trainer might tease the lackadaisical fetcher by repeatedly bouncing the ball against a wall, causing it to fly enticingly close to the reluctant player. Another useful method is to play keep away by kicking or flicking the ball just out of the dog's reach. If the dog happens to pick the toy up, it can be engaged in a gentle tug contest for possession. Interest in the ball can also be enhanced by playing "monkey in middle," keeping the ball just out of the dog's reach. At a point when the game reaches a sufficient pitch of excitement, the dog can be allowed to get the ball and keep it for a moment before being called to exchange it for a treat. Playing tug with the dog helps to improve ball drive and its willingness to chase and bring the ball back. Finally, ball drive can be enhanced by keeping the ball away from the dog at all times other than when it is used for play or training. The goal of ball play is to make the dog a fanatic about the ball! Often a few drops of a conditioned odor (e.g., lemon or orange) are put inside the ball to establish an association between the scent and the play activity. Such conditioned odors can be effectively used in the management of a variety of behavior problems.

Getting a dog to chase a ball is often more easy than getting it to bring it back. Many dogs welcome the opportunity to play keep away, especially if the owner is game and offers a chase. Keeping the dog on a long line and giving it a treat in exchange for returning and releasing the ball helps to encourage good retrieving habits. Each time the dog returns with the ball, a food reward is offered to it, causing the dog to release the ball in order to obtain the treat. After a moment, the ball is tossed again, and the dog is encouraged to return with it by making smooch sounds, clapping, crouching down, and so forth. Training the dog to come to a closed hand for a variable food reward is a useful preliminary for dogs that habitually refuse to return with the ball. Eventually, the release of the ball is brought under the control of a release signal like "Out," spoken just before the dog releases the ball. Another way of improving the dog's willingness to return with the ball is to use a second one as a trade. The dog is required first to drop the one it has before the second one is thrown. The long line provides additional control by preventing the dog from running off with the object or refusing to come back with it.

With a foundation of ball play and retrieve in place, an improved willingness to come when called can be developed. In fact, there is no better time to introduce recall training than during ball play. After sending the dog to retrieve the ball, but just before it turns to bring the ball back, the trainer says the dog's name and waits until it turns fully around before saying "Come" in a crisp and playful tone of voice. The command is followed by encouraging praise and clapping, crouching down, or running backward in the case of hesitant dogs to encourage them to come more enthusiastically. The dog soon learns that the command "Come" is linked with a treat and the opportunity for more play. Besides learning to come on command, the dog can also be taught to wait briefly before the ball is tossed again. This is accomplished by saying "Wait" prior to each throw while having the dog focus on the ball, thereby enhancing attention and impulse control under the strong motivation of play. The act of waiting is reinforced by the whole chain of events: the opportunity to chase, fetch, and drop the ball into the trainer's hand—all eventually leading to the acquisition of food and the opportunity to play again.

PART 3: TRAINING PROJECTS AND EXERCISES

Introductory Lessons

The introductory lessons are largely the same for both puppies and adult dogs. The goal of these early lessons is to establish a foundation of attention and impulse control within the context of reward-based training.

Bridge Conditioning

Conditioned reinforcers serve to bridge the occurrence of some target behavior with the delayed delivery of unconditioned reinforcers (see *Shaping: Training Through Successive Approximations* in Volume 1, Chapter 7). Consequently, conditioned reinforcers are often referred to as bridges or bridging stimuli. Bridge conditioning is usually carried out under relatively distraction-free conditions in the house or yard. A variety of soft and hard treats are prepared and placed in small hip pack or belt pouch, and the web handle of the ball is passed under the belt, making it easy to access. Both food pouch and ball should be kept on the trainer's right side. The dog should be slightly hungry and rested at the start of training. Social and food deprivation is rarely necessary to heighten the appetite of a healthy and emotionally balanced dog to work for food and social rewards. The first step in the process of conditioning the bridging stimulus or bridge is to allow the dog to sample the food reward from the right hand. Food treats should be consistently given with the right hand. A tiny piece of the food reward is given to the dog first from the fingers and then from a closed hand as it approaches. A small bit of food can produce a surprisingly strong food incentive, probably as the result of the dopamine reward signal produced by the activation of an olfactory incentive system (see *Olfactory Incentive System and Prediction Error* in Chapter 10). Modal seeking activity associated with food is rapidly invigorated and is highly responsive to the activation effects of surprise. The sampling or priming process is repeated until the dog enthusiastically searches and follows the trainer, seeking the food reward. As the dog reaches the trainer, the vocal bridge "Good" is spoken in a clipped and high-pitched tone just before the food reward is delivered to the dog from the right hand. The food reward should be concealed in a closed hand, requiring that the dog touch it and briefly wait, whereupon the bridge "Good" is delivered just before the hand is opened. Gradually, the dog should be encouraged to follow the right hand actively as it is moved in various directions before the reward is delivered. The trainer should move around the training area and encourage the dog to follow; as it turns, the trainer crouches down and flicks the right hand out to the side, attracting the dog's attention and saying "Good" as soon as the dog touches it. Alternatively, a clicker can be sounded just as the dog turns toward the trainer, and followed by the vocal bridge just before the closed hand is opened. The process of pairing the bridging stimulus with food rewards is repeated until the dog shows a clear anticipatory response to the sound of the bridge.

As a standard expectancy is established, variations can be introduced to enhance bridge conditioning. For example, varying the duration between trials, so that some occur sooner than others, produces a surprise in relation to the expected timing of reward. Also, varying the length of time taken to open the hand containing the food reward can also provide a similar element of surprise. Periodically, instead of having the dog come to the hand, the food reward is tossed to it immediately after the bridge (click) is delivered. As previously discussed (see *Prediction and Control Expectancies*), significant surprise and additional bridge-conditioning benefits can be generated by varying the size, type, and frequency of the reward given to the dog. In addition to conditioning the bridge in the context of reinforcing following behavior, the association can be strengthened by using it to enhance an orienting response whereby the dog is prompted to turn its attention toward the trainer in response to a smooch or squeaker sound followed by a click or "Good." After orienting or coming to the trainer, it can be prompted to make eye contact (attending response), whereupon the bridge and food reward are delivered. Affectionate petting should be frequently given along with food rewards. Affectionate petting

enhances the rewarding event as well as linking the affectionate activity with the bridge "Good."

Following and Coming

After each trial, the trainer steps back a step or two and encourages the dog to come along, guiding it to the left side with the right hand and causing it to turn about there, before stepping forward and encouraging the dog to follow along at the left side. Following behavior is bridged with the clicker, whereupon the closed hand containing a food reward is moved slowly over the dog's head, causing it to follow and sit. As the dog begins to sit, the bridge "Good" is delivered and followed by the food reward as the action is completed. Alternatively, after taking several steps forward, the trainer can call the dog's name and abruptly backpedal away from it, causing it to turn and follow along. Just as the dog turns, the trainer clicks and flicks the closed right hand off to the side. Just before the dog reaches the hand, the trainer says "Come" and then "Good" just before the hand is opened to reveal the reward. At the conclusion of this simple chain, the trainer says "OK," claps, and again guides the dog to the left side, steps away as before, and encourages the dog to follow along at the left side until the trainer once again stops and prompts the dog to sit or steps back calling the dog's name or smooching to encourage it to turn and come. As the dog turns, a click is delivered and, as the dog moves in the direction of trainer, the vocal signal "Come" is spoken in an enthusiastic command tone as the right hand is flicked to the side. As the dog reaches the hand, the bridge "Good" is spoken and the hand is opened. This pattern is repeated several times, establishing an associative link between coming and reward.

Orienting Response

Attention control is of great utility in dog training (see *Attention and Impulse Control*). Obviously, for a dog to be trained, it must pay attention to the trainer's actions. A dog's attention can be attracted by employing various unconditioned or conditioned diverters, evoking surprise and competing interest, e.g., throwing a ball or presenting a conditioned stimulus previously paired with food (e.g., a whistle). In addition, most dogs quickly orient toward unfamiliar or out-of-the-ordinary stimuli. By calling a dog's name just prior to presenting a potent diverter or disrupter, the name is gradually conditioned as a generalized orienting stimulus. As the dog learns to respond to its name by orienting its attention toward the trainer, its name can be used to interrupt distracted behavior and to serve as a preparatory cue for commands. For example, in the case of training a dog to come, its name is used to evoke an orienting response, followed by command cue "Come" and additional prompting and encouragement, as necessary. Since the distracting environment itself is rewarding, releasing the dog after it comes serves to further reinforce the habit of coming when called. Consequently, when the dog reaches the trainer, it is immediately rewarded and released with an "OK" and hand clap. As the result of repeatedly calling and releasing the dog after it comes, it gradually learns to expect that coming not only results in a food reward but also results in another opportunity to explore the environment.

A useful attention-controlling strategy is to pair a whistle or squeaker sound with treats, feeding times, and just prior to other strongly reinforcing events (e.g., access to special toys and announcing owner homecomings). Gradually, the dog learns that the squeaker announces a moment when a food reward is likely to be forthcoming. The whistle is not a recall signal, although it may be conditioned to function as one; rather, it is an establishing operation signifying an opportunity to obtain a variety of possible attractive outcomes if the dog simply orients and takes it. If the dog does not come, no matter; it has simply lost the opportunity to obtain the reward. Additional orienting control is established by bridging the orienting response with a clicker. The click is delivered just as the dog begins to orient to its name, a smooch, or a squeak. The click is followed by a flick of the hand to the right and the delivery of a variable reward

conducive to surprise. For example, varying the size and type of the reward given to the dog can magnify the effect of this training.

Attending Response

Whereas orienting behavior is momentary and strongly affected by reflexive mechanisms, attending behavior occurs with some duration over time and is more directly controlled by instrumental contingencies of reinforcement. Teaching dogs to look up and hold eye contact is an important aspect of dog training and socialization. Making various nonsense sounds (e.g., clucking or lip noises of various kinds) helps to get a dog to look up into the eyes. The moment the dog makes eye contact, the response is bridged and reinforced with an affectionate smile, sweet talk, and a treat. The clicker can be used effectively to help shape attending behavior in dogs that resist making eye contact. Once eye contact is establish, the duration of the response can be gradually increased until the dog is holding it for a second or two. As the dog learns to look up and make eye contact in response to a smooch or cluck sound, its name can be paired with the orienting stimulus. Calling the dog to come and sit and look up briefly before rewarding and releasing it promotes a valuable pattern of control (Figure 1.11). In the case of highly distractible dogs, a squeaker-clicker combination can be useful for capturing and shaping the dog's attention. The squeaker device (extracted from a squeaker bulb) is inserted into a hole drilled into the clicker (see Figure 1.9). A wide range of sounds can be made with the squeaker, minimizing the effect of gradual habituation to the sound. As the dog turns, the clicker is pressed, thereby reinforcing the orienting response. This procedure is repeated under varying conditions of distraction until the dog is quickly orienting to the sound of the squeaker, at which point its name can be paired with the sound.

Targeting and Prompting

Most training activities make use of body or hand movements to prompt, lure, or target the dog's behavior. Training a dog to orient and follow the trainer's body and hand movements is an important aspect of basic training, providing a foundation for more complex and advanced control efforts. Training the dog to take food from the right hand and then requiring that it follow the hand as a contingency for getting the reward helps develop a targeting response to the hand. The dog is trained to target on the hand by holding the right hand at the dog's eye level so that it either looks at the hand (in the beginning) or actually touches it with its nose before the behavior is bridged and rewarded. As the dog learns to orient and follow the hand, the targeting behavior is shaped through successive approximations until it is a strong and reliable response. The attractiveness of the hand as a target can be enhanced by rapidly flapping the first two fingers like beating wings—a technique referred to as a birdie lure. Training the dog to target on the hand allows the trainer to guide or position it without needing to use physical prompts. Targeting provides a rapid means to facilitate the response as well as

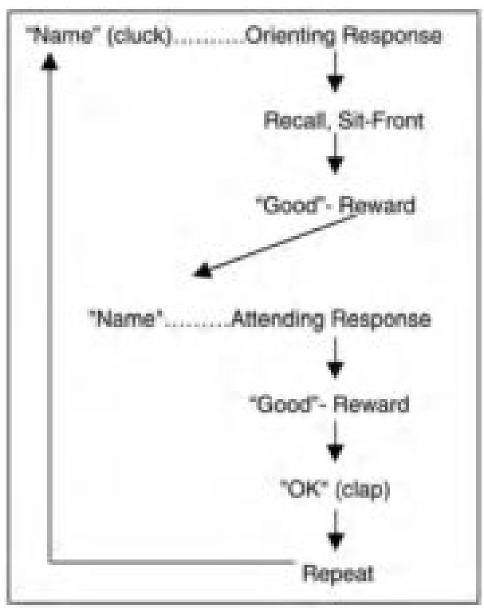

FIG. 1.11. Attention-training sequence: orienting response, recall, sit, attending response, and release.

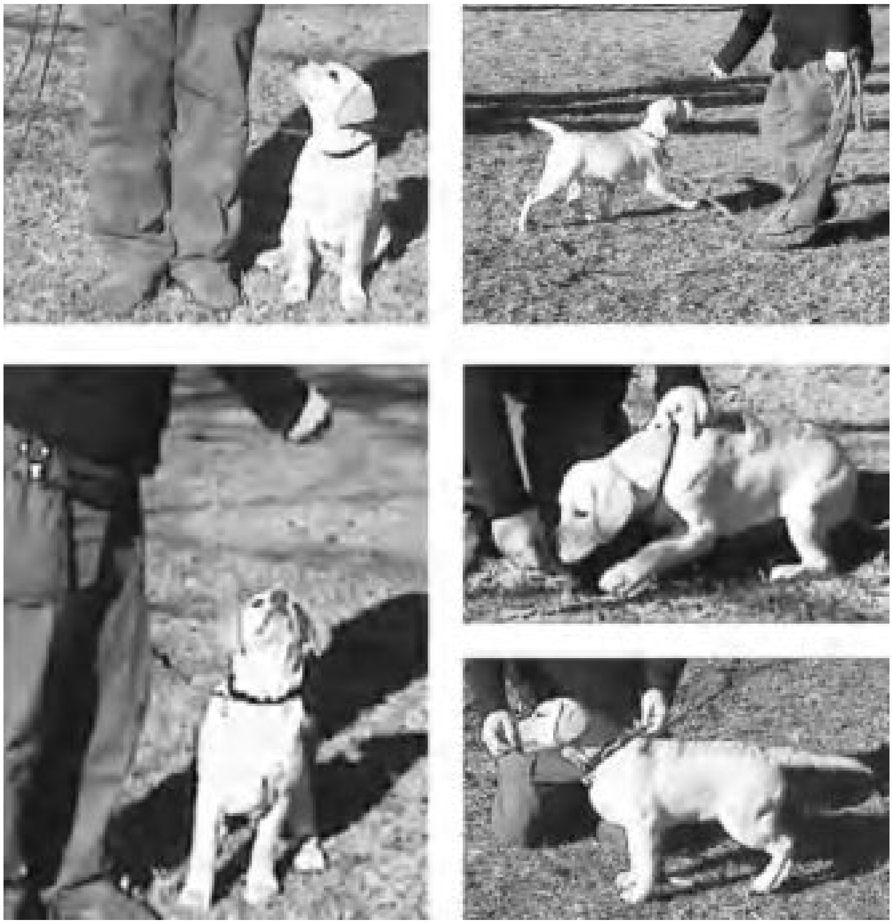

FIG. 1.12. Puppy targeting and prompting.

developing a hand signal to control it (Figure 1.12). Training the dog to reliably orient (turn toward the trainer on signal) and target on trainer's body movements and gestures is the most important objective of basic training.

As the dog's targeting behavior improves, hand and body movements can be used to guide and prompt it into various positions. For example, teaching a dog to sit is easily accomplished by moving the right hand slowly over the dog's head. As the dog follows the trajectory of the hand, there is a natural tendency for it to sit. If the dog jumps up at the hand instead of sitting, the hand can be repositioned to discourage jumping, or the trainer can simply step on the leash to prevent the unwanted jumping behavior. The bridge "Good" is presented just as the dog begins to sit, with the food reward and affectionate petting delivered as the dog completes the action. At the conclusion of the trial, the dog is released with an "OK" and hand clap, guided to the left side, and walked out several steps before the trainer steps back and calls the dog to come again, whereupon it is prompted with the hand signal to sit and is appropriately rewarded. This pattern is repeated until it is performed fluently. Once the dog is sitting reliably in response to the prompting of the hand signal, the vocal signal "Sit" is paired with the action. After several pairings in which the word "Sit" is spoken just before

the hand signal, the vocal signal alone will prompt the sit response. At this point, the hand signal can be progressively delayed or minimized, with the dog learning to respond to the vocal signal alone, gradually enabling the dog to sit in response to the vocal signal alone. If the dog fails to sit when the vocal signal is given, the signal should not be repeated; instead, the hand signal is used to prompt the action. A fairly reliable measure of a dog trainer's understanding of the process and skill can be calculated by the number of times she or he repeats vocal commands. Later on, while training the automatic sit, both vocal and hand signals are delayed or minimized, so that the dog learns to sit without aid whenever the trainer comes to a stop while the dog is heeling or at other times requiring that it sit automatically (e.g., sit-front and starting exercise). Generally, for routine training purposes, it is better to continue giving the dog a combined vocal and hand signal, since the latter helps to progressively strengthen the dog's responsiveness to the former. After rewarding the sit response, the dog is required to wait to be released with an "OK" and hand clap. If, at any point in the process, the dog appears confused or quits, the trainer should go back to the hand signal or review a previously successful step (e.g., "Come" or "Good" conditioning, attention training, and targeting on the hand) and begin again.

As the dog is guided around to left side at the conclusion of the come exercise, it can be prompted to sit at the trainer's left side and be rewarded. After a brief moment, the trainer steps off and encourages the dog to follow along with the vocal signal "Come one," sweet talk, smooches, or slaps on the leg. As the dog orients toward the left side and continues there for a few steps, the trainer stops and prompts it to sit. If the dog runs out ahead, the trainer should turn into an opposite direction while making smooches, slapping the left thigh, or crouching down to encourage it to follow along in the new direction. As soon as the dog responds, the bridge and reward follow. If the dog moves off to the left, the trainer turns to the right and encourages the dog to follow along. If the dog lags behind, the trainer picks up the pace with gentle encouragement, perhaps bouncing a ball, making smooch sounds, or crouching down momentarily. Whenever the dog comes close to the trainer's side, the bridge and treat are delivered. After a change of pace, a turn, the dog's close walking is bridged (e.g., click) and it is prompted to sit at the trainer's left side, rewarded, and the sequence is repeated. With every successful walk-sit sequence, appropriate bridging and rewards follow. While training the dog to come along and walk close by, the trainer can mix in come and sit-front training as together with orienting and attending sequences.

Most dogs can rapidly learn to lie down from the sit. The task is usually introduced with the trainer crouching down or sitting on the floor and luring the dog down with the right hand. In some cases, the behavior may need to be shaped through successive approximations, starting with a downward bobbing movement of the dog's head, a reaching movement toward the floor and, finally, lying down. As the dog learns to follow the hand into the down, the vocal signal "Down" is paired with the hand signal. The dog should also learn to sit from the down and stand from the sit. Using a hand-targeting strategy helps the dog to learn both of these movements easily. If the dog ignores the hand, the birdie lure can be used to attract its attention. Once the dog is lying down, the trainer moves the right hand upward in front of the dog's nose, causing it to follow the movement. Similarly, the dog can be prompted in the stand position by putting the right hand in front of the dog's nose and drawing it away, thereby causing it to stand. This basic cycle of exercises (sit, down, stand, and sit) can be performed with a toy as a lure and using an opportunities to tug and fetch as a reward. As the dog masters each movement, an appropriate vocal command is paired with the hand signal. In the case of resistant dogs, a food lure (usually a small biscuit) is used to break the ice. Luring with food can be very problematic, however, and should only be used to get a response that is not likely to happen in a timely way otherwise. After two or three luring trials, the biscuit should be hidden in a closed hand and finally faded completely out.

Excessive reliance on food baiting and luring tends to produce "chow hounds," that is, dogs that will only work with the direct promise of a food reward in sight.

Stay Training

Once the dog is readily orienting, coming, sitting, and looking up on signal, the sit-stay exercise is introduced (see Appendix A). Many aspects of the stay module have already received preliminary training. For example, after coming and sitting, the dog has been required to wait a moment, steady its attention, and make eye contact as a contingency of reinforcement and release. Once these preliminaries are under control, it is an easy and natural step to train the dog to stay for longer periods and at greater distances from the trainer. The first criterion is to have the dog hold a sit-stay for a progressively longer and then variable duration before the behavior is reinforced. The variable duration of the stay response provides an interesting source of prediction error (surprise) with which to strengthen waiting and attending behavior. Releasing the dog sooner than expected relative to a standard expectancy provides a surprise and reward that can be used to steady attending behavior, especially if the dog is prompted to make eye contact in advance of being released. Similarly, vary the amount of time that the dog waits before being let outdoors, to come up on furniture, to receive a favorite toy, to be permitted to jump up, and so forth can help to strengthen waiting strategies and improve delay of gratification. The next criterion is staying as the trainer steps away a step or two. As the trainer steps back, a stay flag is presented, which is formed by extending the right arm in front of the body at chest level, with the right hand held out. The fingers should be held together and pointed up, with the palm facing the dog.

Initially, the dog is required to hold the sit-stay position for a brief period before it is rewarded. The best stay performances are built up carefully and slowly in the context of attention training. Ideally, the dog should maintain eye contact with the trainer as he or she steps back and again as the trainer returns to the dog. The dog should also maintain steady eye contact just before being released. The release should be treated as a trained response that is brought under the control of play activities (e.g., tug and ball play). During the early phases of stay training, it is important that the trainer return to the dog instead of calling the dog to come at the conclusion of the sit-stay period. If the dog happens to break the stay position, it is lured or guided back by leash to the original spot and prompted to sit. Breaking the stay during early stages of training should be treated as a mistake of judgment on the trainer's part rather than an act of obstinacy on the part of the dog. When the dog breaks the position, it is best to simply try again at an earlier and more successful step. With every successful stay performance, the dog is rewarded (food, petting, praise) and released momentarily between trials, often engaged in play. Ideally, the process should proceed with a minimum of errors, but, in practice, learning from mistakes can also be very beneficial, so long as it does not result in excessive anxiety or frustration. The goal of sit-stay training is to enhance impulse control, not by anxious inhibition, but rather by training the dog to focus and relax. Patience in the process of training the dog to sit and stay is rewarded later on.

The most common problems encountered during the early stages of stay training involve impulsive behaviors associated with distractions. These motivations can be turned to the trainer's advantage by making access to them contingent on the dog waiting or staying first. An affirmative way to view distractions is to consider them as potential rewards not yet under the trainer's control. In the case of some highly excitable dogs, training efforts may be impeded by such distractions. Normally, distraction-dense environments are avoided until a dog's attention and impulse-control abilities are adequately prepared to meet the challenge.

Play and Controlled Walking

The controlled-walking pattern is shaped through successful approximations. The easi-

est way to introduce the walking behavior is through play. The first step is to encourage the dog to chase and retrieve a stick or ball. As the dog becomes excited about the toy, it is held in the right hand and used to guide the dog around to the left side. If the dog goes too far out in front, the trainer turns about while making smooch sounds and tapping a stick to the ground and encouraging the dog to follow along. When the dog returns to the trainer's side, the stick is tossed for the dog to retrieve and to come back for a tug and treat in exchange for releasing it. After a brief tug, the dog is prompted to release the stick and is lured as before to the starting position at the trainer's left side. The stick is held diagonally in front of the trainer, just out of reach of the dog, and the trainer steps off on the left leg, whereupon the stick is tapped against the front surface of the thigh, accompanied with clucking or smooching sounds to attract the dog's attention. With the dog walking close on the left side, the bridge "Good" is delivered, and the trainer comes to a stop and prompts the dog to sit by waving the stick in an upward direction over the dog's head, causing it to sit. As the dog sits, it is praised, treated, and given another opportunity to fetch the stick. Instead of using a stick, a tennis ball with handle can be used in a similar way. Gradually, the dog is required to hold the sit for longer durations before the stick is thrown. For some insecure dogs, a food lure or licking stick (e.g., a yardstick with peanut butter or crème cheese smeared on it) can be a helpful means to introduce the concept of walking close at the left side. The food lure or licking stick is held a few inches in front of the dog, allowing the dog to lick occasionally while walking or after being prompted to sit.

Clicking and Controlled Walking

Another very effective way to introduce attentive controlled walking is by using a clicker. While walking the dog on a leash, a click is delivered so long as it remains on the trainer's left and walks close by without pulling. With each click, the trainer stops and prompts the dog to sit, whereupon the trainer says "Good" and the treat is delivered. Initially, the click-and-treat procedure is repeated every few steps, but gradually the dog should be required to walk without pulling for longer periods before delivering the bridge and reward. If the dog pulls, its name is called as the slack of the leash is let go; alternatively, a squeaker is sounded to get the dog's attention and cause it to turn around. Just as the dog turns in response to its name or squeaker, the click is delivered and the dog encouraged to return to the trainer's left side, whereupon it is prompted to sit and is given a treat. The combination clicker-squeaker is convenient for such training. Under distracting conditions, repeated and sustained reinforcers involving several small pieces of food, petting and massage, play, and vocal encouragement may be helpful to keep dogs focused and on track.

On-leash and Off-leash Practice

It is important that trainers practice the above tasks with puppies or dogs both on and off leash. Although an experienced trainer can carry out initial training efforts effectively with a dog off leash, it is usually best to work the puppy or dog on leash or long line and then gradually introduce off-leash elements as the various necessary skills are mastered. Backup leash control is particularly important in the case of dogs and puppies receiving training to curb social excesses and impulsive household behavior. Although beneficial in the early stages of training, overreliance on the leash control may cause both the trainer and dog to become dependent on it, thereby making it much more difficult to fade it out later. Reducing dependency on the leash requires that the trainer master skills needed to control a dog with vocal signals and gestural prompts alone. Also, during training periods when the leash is off, the trainer gets a more accurate picture of what the dog actually knows as the result of training. Control is meaningful only to the extent that it can be exercised both on and off leash. When the dog is worked off leash, mental notes should

be kept about areas of training that may require additional work on leash.

WALKING ON LEASH

A dog's excessive pulling and lunging while on leash is perhaps the most common reason for owners to seek training help. While a confident and well-trained dog is an object of owner pride and affection, an impulsive and rambunctious one can rapidly become a source of tremendous frustration and public embarrassment for the owner (Sanders, 1999). In some cases, the owner is physically unable to walk the dog because of excessive pulling and various misbehaviors that occur while on leash, further complicating matters by giving rise to deficiencies associated with inadequate exercise and outdoor stimulation. Consequently, such dogs may become progressively difficult to handle and manage, setting the stage for the development or exacerbation of behavior problems associated with excessive activity and impulsiveness. Training dogs to walk properly on leash is vital, not only to develop and augment attention and impulse control, but to strengthen the leader-follower bond, as well. The dog that walks in close cooperation with the trainer's pace and direction takes each step and turns in acceptance and deference to that person's role as leader. Training the dog to walk properly and skillfully on leash provides a foundation for a more positive and mutually rewarding experience for both the person and the dog.

Even though pulling into a leash results in physical discomfort for a dog, forcefully holding the dog back appears to increase rather than reduce the magnitude of its pulling efforts. Pavlov (1927/1960) postulated a *freedom reflex* to help explain the dog's oppositional response to restraint. Reflexive opposition to restraint has biological significance, since, as Pavlov points out, "it is clear that if the animal were not provided with a reflex of protest against boundaries set to its freedom, the smallest obstacle in its path would interfere with the proper fulfillment of its natural functions" (12). A related phenomenon, thigmotaxis (Gk, *thigma* or touch), refers to reflexive adjustments associated with taction, but should be distinguished from Pavlov's oppositional freedom reflex. Thigmotactic adjustments are divided into two categories, depending on whether a dog moves toward contact (positive thigmotaxis) or moves away from contact (negative thigmotaxis). Common examples of positive thigmotaxis include the rooting reflex or the tendency of fearful dogs to lean on the owner's body as a source of security. Physical opposition may also excite positive thigmotaxis, but since the dog's efforts at such times appear primarily intended to oppose the physical control, it may be more appropriate to refer to such behavior as an opposition reflex rather than thigmotaxis. Perhaps the concepts of positive and negative thigmotaxis should be reserved for describing contact behavior occurring at times when seeking comfort or safety rather than frustrated behavior associated with physical force or barriers.

When confronted with physical forces and obstacles that thwart their freedom of movement, a dog reflexively responds with commensurate oppositional behavior aimed at countering their effects. For example, the harder the owner pulls back on the leash, the more the dog will tend to pull forward (forge) against it. Similarly, if the dog is pulled forward, the dog will tend to compensate by pulling back (balk), as opposition reflexes are elicited. The motivational effect of opposition is frustration. The typical behavioral response to frustration is potentiation and persistence of oppositional behavior. The amount of oppositional effort expended by the dog depends on a number of factors, but especially upon the value of attractive incentives toward which the pulling action is directed. The primary goals of the activity appear to be the optimization of drive-activating stimulation and control of the direction and pace of the walk. Few dogs find pulling into the leash sufficiently aversive to stop doing so, even in cases where their breathing and circulation are affected by the activity or where obvious discomfort is involved.

Although holding the dog back briefly is not harmful, passively holding the dog back by a dead leash for extended periods to break its will to pull (freedom reflex) is a highly questionable practice. The theory promulgated by proponents of the method is that the

dog will eventually cave in and defer to passive restraint, but actually such stimulation often evokes a persistent oppositional reflex causing the dog to continue pulling despite significant discomfort and physiological distress. Instead of discouraging pulling, such restraint often does little more than increase frustration and oppositional behavior. The procedure has become increasingly popular as a means to discourage pulling, partly because of its simple theory and application—any ambulatory person with a strong back and arms can stand like a post and hold a dog back and thwart its oppositional pulling efforts. For such methods to have a chance of success, they require a great deal of consistency and perseverance. Unfortunately, however, ordinary dog owners are often woefully deficient on both scores and will frequently ignore pulling efforts rather than consistently perform the rather tedious ritual of waiting until the dog stops pulling before taking a step forward. As a result, the pulling behavior may never get better, but instead may grow significantly worse as the result of frustration-related enhancement and intermittent negative reinforcement. Finally, given the availability of effective leash-training alternatives that work quickly and reliably to discourage pulling, letting a dog pull on leash until its will to pull is broken (i.e., the opposition reflex is fatigued) or until it becomes exhausted makes little sense. In cases where an owner is unable or unwilling to assert appropriate leash control, a halter can be introduced to passively control pulling excesses.

Not only are such leash-breaking methods questionable with respect to efficacy, they risk producing significant harm if performed on dogs that persistently pull while being exercised. Pulling continuously on a leash can impede efficient ventilation and blood circulation, thereby hampering the dog's ability to circulate and cool arterial blood before it enters the brain. While a dog is walking or running, arterial blood rapidly heats up and needs to be cooled to prevent brain damage associated with thermal stress. Blood entering the brain is cooled by passive thermal exchange between arterial and venous vessels, whereby heated arterial blood is cooled by venous blood draining from the nose and mouth of the dog (Baker and Chapman, 1977). As the result of holding a dog back by a collar around its throat, both ventilation and venous blood flow are variably obstructed, depending on the force of pulling and the sort of collar used to restrain the dog. Venous blood flow is more easily obstructed by external pressure on the neck than is arterial flow, which passes through the neck under pressure and is partially protected by the spine (vertebral artery). The net result is that heated arterial blood continues to pump into the brain while decreased ventilation and obstructed venous blood flow hamper its efficient cooling—a physiological condition capable of producing significant harm or discomfort to dogs laboring under adverse weather or exercise conditions. Intentionally allowing impulsive or oppositional dogs to pull into a dead leash is tantamount to *horizontal hanging*—a procedure that is difficult to justify as a humane means to stop or control excessive pulling by dogs.

Most dogs exhibit intense preparatory arousal whenever the owner gets the leash to take the dog for a walk. In the case of a pulling dog, the appearance of the leash functions as an establishing operation, motivationally preparing the dog to pull and to obtain reinforcement as the result of such behavior.

Dogs that engage in excessive pulling are often inordinately attracted to environmental stimuli and engage in excessive exploratory and stimulation-seeking activities. In addition, such dogs are often hyperactive and may exhibit marked impulse-control and attention-related deficits that require training efforts designed to enhance attentional focus and executive restraint. Various diverter-type and disrupter-type stimuli are employed to interrupt pulling and to refocus a dog's attention. A squeaker-clicker combination can be used to get and then reinforce attention and orientation toward the trainer. Giving such dogs an opportunity to engage in vigorous ball play before going for a walk can help to reduce pent-up energy fueling excessive pulling behavior. Moving from the play situation to a long line and then to a short leash appears to make the transition easier for many dogs because it helps to reduce oppositional

reactivity and impulsive behavior when on leash.

Leash Handling

There is a certain amount of truth to the adage "Master the leash, master the dog." Before describing the basic techniques of leash training, leash-handling lore and methods need to be reviewed briefly. There are many ways to hold and handle a leash. One of the best methods for routine training purposes is first to place the thumb through the leash loop and then close the hand around it, forming a fist (Figure 1.14A). A more secure control is obtained by passing the hand through the loop and bringing the leash over the top before gripping and setting the trigger (Figure 1.13). Next, in order to take up and grip the slack of the leash, the first two fingers are extended, with the third and fourth fingers flexed firmly on the leash handle (the *grip*). The shape of the hand at this point looks like the Scout salute. A variable length of the leash is taken up into a single fold and held between the thumb and the index finger (the *trigger*) (Figure 1.14F and G). When walking a dog on a slack leash, the leash is held in the left hand. When practicing or performing formal exercises, however, the leash is dressed in the right hand. The leash is dressed with the dog in the starting position, and both arms are fully extended and relaxed. The *standing end* and slack of the leash is held in the right hand while the *working end* runs slackly down and across the trainer's left leg to the dog sitting at heel (Figure 1.14G).

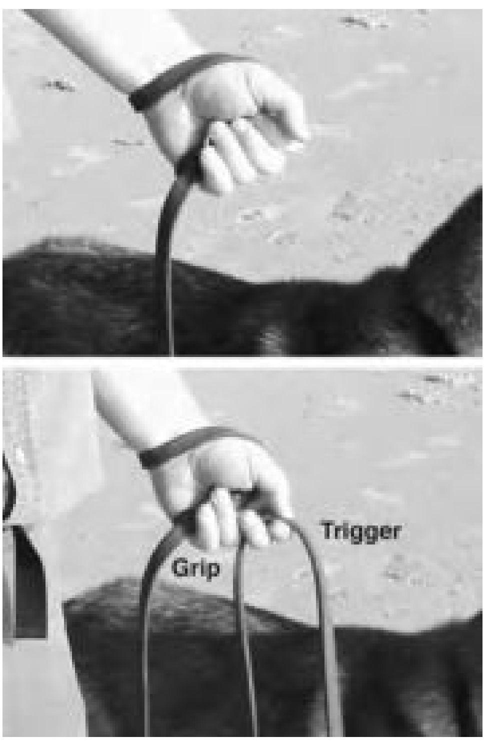

FIG. 1.13. Secure leash control.

In addition to holding and dressing a leash, trainers should be familiar with three leash manipulations: breaking, opening the leash, and changing leash hands. Breaking prevents the leash from slipping through the fingers. Many styles of leash braking are used in dog training. The most common brake is set by taking the working end of the leash with the left hand and wrapping it over the left thumb and then firmly closing the hand over the leash (Figure 1.14D). Thumb brakes are particularly useful when working with large breeds or when using nylon leashes that tend to slip through the hands. The leash is opened by taking up the working end with the left hand and setting a thumb brake before realeasing the slack held in the right hand. As the brake is applied, the left hand draws the leash open, thus freeing the right hand (leash still hung from the right thumb) to present hand signals or treats (Figure 1.14D). Besides opening the leash, trainers should know how to change leash hands properly. There are two basic ways to change leash hands. When passing the leash between hands, both its working and standing ends are gripped together just beneath the handle (Figure 1.14E). As the right hand lets go, it leaves a glovelike shape impressed into the leash fold and handle. The leash is dressed again by regripping the handle and the fold of slack as previously described. Another method for changing leash hands involves moving the thumb upward and causing the leash handle to shift up (Figure 1.14A–C). Now, the opposite thumb can hook the handle and take up the standing slack in a single fold. When the dog is located in front of the trainer or at some distance away, the leash is exchanged in a similar way between hands by the thumbs, and the standing slack is taken up as needed. The leash

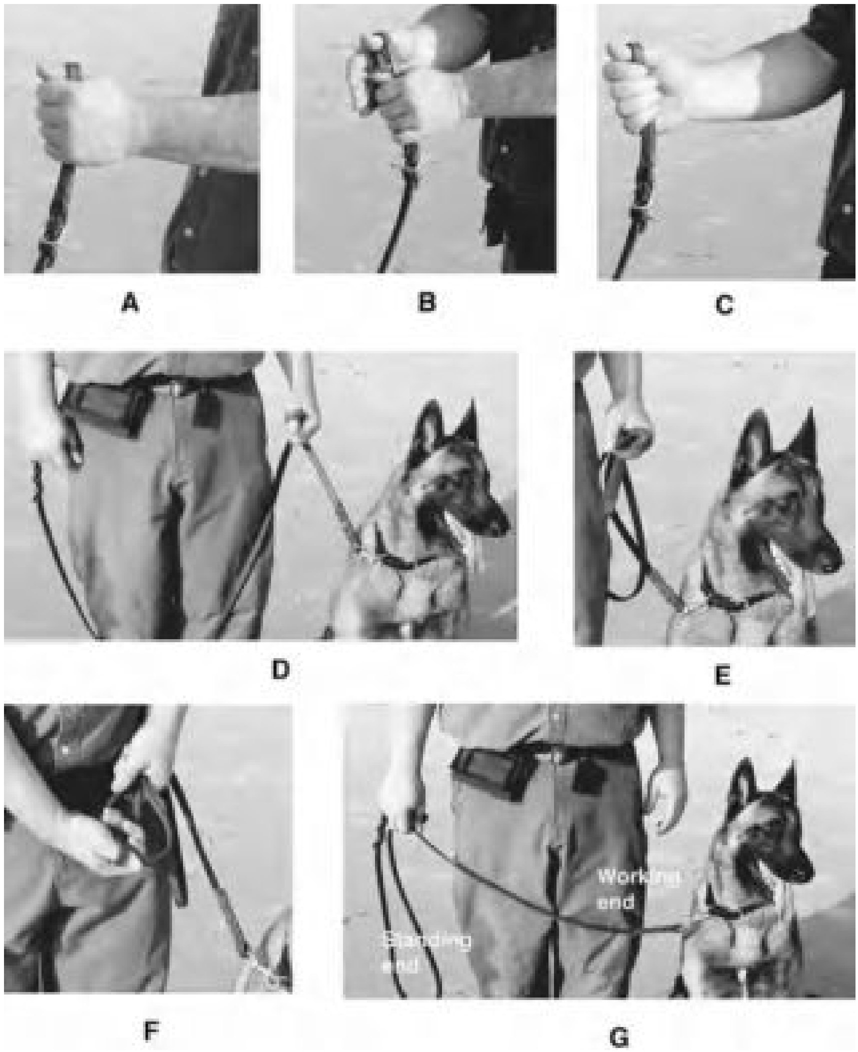

FIG. 1.14. Leash handling: basic leash control **(A–C)**, opening the leash and brake **(D)**, changed leash hands **(E)**, setting the trigger **(F)**, and dressed training (starting position) **(G)**.

should never tangle to the ground—it should always have a presence of control but never be taut. Leashes should never be knotted, except as needed to form temporary looping for hip-hitching or coupling techniques in which two leashes are tied together to control a brace of dogs.

Leash-training Techniques

Choosing the appropriate method for a dog's needs is of tremendous importance. Some dogs may require very little in the way of directive or physical prompting, whereas others will require more forceful handling strategies. Four techniques are generally used, depending on a dog's needs:

1. Long-line training involves the use of reward-based attention-control techniques and avoidance cues ("Easy" and "Stay") together with stepping or tamping on a long line dragging on the ground.
2. Slack-leash training involves using an abrupt release of leash slack to simultaneously capture the dog's wavering attention and

deter future pulling with appropriate anchor and opposing thrust movements.

3. Hip-hitch training is based on a response-blocking strategy in which forward movement is interrupted by stopping, back-stepping, and otherwise preventing the dog from moving forward until it stops pulling and momentarily turns its attention to the trainer.

4. Halter training prevents pulling by using a halter-type collar and stresses positive reinforcement to shape attention and walking without pulling.

Working the dog outdoors among distractions is a major transition that often requires the addition of directive methods of control. The preliminary work done indoors and in the backyard has taught the dog what is expected of it through a reward-based training system, but knowing what to do and possessing a reliable ability to do it are two very different things. Although the dog may know how to sit or lie down and stay on signal, it may not be willing to perform the tasks as obedient acts on command, especially in situations where it would prefer to do something else. In such cases, it may be necessary at times to constrain the dog to perform the required behavior by means of directive prompting. Most importantly, however, as noted earlier, the social limit around pulling on the leash is of vital importance. The leash represents a physical extension of human will, which when properly introduced and used provides a dog with a valuable source of guidance and instruction. As such, the dog must first learn to defer to the leash and actively follow its directive movements and prompts without hesitating or resisting. A central goal of slack-leash training is to condition a dog's attention to respond to the leash so that it actively follows its guidance, thereby facilitating reward-based training efforts while minimizing exposure to leash corrections.

There are three ways that a dog is walked when outdoors, depending on the control needed at the time: slack leash, controlled walk, and heeling. Slack-leash training only entails that the dog not pull while on leash. During slack-leash walks, the dog is permitted every *reasonable* liberty, such as sniffing about, moving from one side to the other, lagging behind, or forging ahead. The only liberty forbidden to the dog is pulling or lunging into the leash. Controlled walking adds the criterion of walking at the left side without forging beyond the point where the dog's hip aligns with the trainer's left leg. Walking at heel is an entirely different matter. Heeling is a highly structured and formal activity requiring that the dog walk in a precisely defined position at the owner's left side without sniffing or moving about. Heeling is a demanding activity requiring that the dog focus its attention on the trainer's every movement. Although restrictive and highly formal, walking at heel should not appear overly constraining or mechanical. Instead, an appearance of elegant harmony between the owner and dog should cause observers to reflect on its meditative qualities. In fact, good heeling is a meditation, bringing both dog and trainer into an attentional nexus of single-mindedness on the moment. This sort of effort requires tremendous concentration and can been done only for short periods in the beginning, with the dog heeling for longer stretches of time as its ability to focus improves with maturity and training. On an average walk, the dog should only be brought to heel periodically and released, with 90% of the walk enjoyed at ease but without pulling.

Long-line Training

Highly active dogs can be first exposed to leash control on a long line. A 30- to 50-foot length of quarter-inch braided white nylon rope is fitted with a knotted hand loop and a limited-slip collar (Figure 1.8). Alternatively, the long line (soft nylon webbing) can be fitted with a knotted fixed-action halter. The long line can be either held in hand or allowed to run freely on the ground. The long line is controlled both by tamping or stamping actions (foot braking) to limit pulling behavior and to gather and focus the dog's attention. Whenever the dog rushes beyond 10 to 15 feet away and ignores other established orienting and attention-controlling signals, the long line is tamped or stepped on and the dog prompted to return to the trainer, required to wait briefly, and released

again. In addition to a free-running procedure in which the long line is let to drag on the ground, a hip-hitch and control lead are used in combination to refine control efforts. Whereas the hip-hitch provides a reliable means for blocking and countering pulling efforts, the control lead gives the trainer the ability to abruptly block and guide the dog's behavior with directive prompting. An added benefit of the hip-hitch is that it frees the trainer's hands to deliver rewards and manipulate bridging devices. During long-line training, the dog is called by name to get its attention in anticipation of tamping and stamping actions. "Easy" is paired with the tamping action, whereas a firmly spoken "Stay" command is paired with the abrupt stamping on the long line to block lunging. As the dog is brought to a halt, the trainer either goes to the waiting dog or recalls it before rewarding and releasing it to continue the walk. During long-line training, the dog is periodically called by name together with an orienting prompt (e.g., squeaker, whistle, or clap), as necessary, clicked as it alerts and begins to turn its head, and is recalled with the vocal command "Come" and hand signal. Upon reaching the trainer, the recall is bridged with "Good" and a variable reward, whereupon the dog is immediately released with "OK" and hand clap. In addition to food rewards, the dog is offered tug and ball-play activities while worked on the long line. A balking or lugging dog is encouraged with slaps on the thigh, crouching, change of pace, and enthusiastic voice and hand gestures paired with "Hurry up."

Slack-leash Walking

With the prospects of a walk, most dogs become excited and active, an enthusiasm that spills over into the walk itself. The first step, therefore, is to organize the various preliminaries to a walk in a way that is conducive to improved impulse control. Obtaining noncontingent treats at such times can help to modulate a dog's excitement by way of diversionary appetitive arousal and incompatible establishing operations. As the dog's interest turns toward the trainer in hopes of getting more treats, various behaviors that have been previously conditioned with food reinforcement are more likely to occur, making control at such times easier. The leash should not be put on the dog until the dog settles down and sits or stands quietly, thereby making the leash a contingent reward based on compliance. Further, the dog should wait at the door briefly before being released. By using a well-conditioned orienting stimulus (squeaker), the dog's attention can be turned to the trainer and bridged (click), whereupon the dog is guided from the door before the vocal bridge ("Good") and food reward are presented. The dog is gradually trained to back away from the door by calling to it "Back" before opening the door. In some cases, tossing a treat back as the door is opened will help to encourage the dog to turn or back away when the door is open. Preliminary reward training at the door should be integrated as a routine and prerequisite to going for a walk. If the dog bolts through the door, it is brought back inside, and the procedure is repeated. Directing the dog away from the door with the leash as the door is opened can be helpful. In addition to backing up as the door is opened, the dog should learn to wait in the doorway for a release signal (e.g., "OK") before exiting the house. The goal is to train the dog to back up as the door opens and then to wait at the doorway under the vocal signal "Wait," until it is released with an "OK." These compliant behaviors are gradually brought under the control of the rewarding opportunity to go for a walk.

The foregoing procedure is repeated until the dog defers and waits quietly before being allowed to go through the door. In the case of highly motivated dogs, exclusionary time-outs (TOs) can be used to reduce preparatory arousal associated with going for a walk. The reprimand "Enough" is spoken in a firm tone and the dog put outside for 30 seconds with the leash pinched in the doorjamb. The TO procedure is repeated until the dog calms down and defers to owner control efforts, whereupon reward training is reinstated. The TO procedure not only reduces preparatory arousal and undesirable behavior, it also makes it more likely that the dog will hesitate and back away as the door is opened. If, despite these training efforts, the dog charges

through the door, the leash is pulled back and the door is closed on it, leaving the dog in TO on the other side. This procedure is repeated until the dog hesitates at the door and waits for the release to leave the house.

Once outdoors, pulling into the leash is handled with appropriate countermovements and directive prompts. The strength of such prompting is matched to the dog's effort to pull and its sensitivity to such stimulation. The strength of directive leash prompts is determined by the dog's forward momentum. The dog can be fitted with a limited-slip collar, strap collar, or harness, depending on the specific needs of the dog and owner. During the slack-leash walk, the leash is held in the hand closest to the dog. Approximately two-thirds of the leash is taken up in a single fold, referred to as a *bight,* and held between the thumb and first two fingers of the left hand (see the aforementioned directions for holding a leash). The properly dressed leash always has at least two points of slack (or life) in it. If both the standing and the working slack are lost, the leash is dead, and a small bight of standing slack (life) must be wrestled up before an effective leash prompt can be made. Whether on a slack-leash walk or while heeling, a small bight of the standing end of the leash is always kept in hand. In addition to standing slack, some amount of slack is kept in the working end of the leash. In some cases, a leash is held with a *bight and pinch* during controlled walking (Figure 1.15). A *pinch* is a small amount of leash slack that is taken up and held between the index finger and thumb and released as a warning in advance of dropping the standing slack. When the working slack is pulled out of the leash by the dog, the standing slack is released as both hands are brought together on the handle as one holds a bat. In the same instant, the trainer takes one step back on the left leg and firmly anchors the leash just in front of his or her belly. Alternatively, if the leash is held in the right hand, the trainer steps back on the right leg before bracing against the dog's forward momentum. Sidestepping to the left or right of the dog's line of movement can help to minimize the amount of force needed to disrupt its forward movement and turn it

Fig. 1.15. Bight and pinch provides a third point of life in a leash.

about. Coordinating the movements of the body into one brief, unified thrust against the dog's forward momentum generates the leash prompt—not jerking, yanking, or pulling against a dead leash. If the dog charges at an awkward angle, the trainer should follow and align with the dog's direction of pulling before releasing the standing slack, anchoring the leash, and thrusting back. If the prompting action is properly applied with sufficient force, the dog will turn toward the trainer. As the dog turns, the trainer should immediately encourage it to come back and guide it to turn about at the trainer's left side, where it is prompted to sit or stand and briefly wait before being released to walk ahead again. Another variation of this method involves using a hip-hitch and stopping whenever the dog pulls for a count of 3 before the leash slack is dropped and the trainer steps back and anchors the leash, as described previously. Again, just before the standing slack is released, the owner calls the dog's name. This variation appears to be easier for some dog owners to carry out, allowing them to take one step at a time. The slow count is gradually varied so that it is delivered sooner (e.g., sometimes as soon as the dog pulls on the leash) and later than expected, thereby producing prediction error conducive to enhanced attention and avoidance of pulling.

As the result of the foregoing procedure, the dog rapidly learns to anticipate the leash prompt whenever the standing slack is loosed abruptly from the trainer's hand. The dog also learns another important lesson: the prompting action can be avoided by responding quickly and slowing down just as the trainer lets go of the leash slack. Once it is evident that the dog understands these connections, the dog's name is called just before the slack is dropped, thereby bringing the new behavior under additional stimulus control and enhancing the nominal orienting response. Now, as the dog pulls, its name is called and the leash slack is dropped, thereby causing the dog to hesitate and turn without necessitating physical prompting, whereupon it is called ("Come") and appropriately rewarded. With practice, the dog will stop pulling altogether as the result this simple procedure combining directive leash training and positive reinforcement. However, until a high degree of reliability is obtained, the trainer must remain prepared to interrupt the dog's pulling efforts every time they occur. While walking on a slack leash, the dog is permitted to move freely about, sniff, lag behind, dart ahead (unless excessive), and otherwise enjoy itself; the only requirement is that it not pull against the leash—ever. As pulling behavior is controlled, a DRO schedule can be introduced such that the dog is conditionally reinforced regardless of what it is doing at the moment so long as it has not pulled for some brief period—a duration that is progressively lengthened as the dog's behavior improves. Orienting, sit, stay, and release modules can be practiced intermittently during slack-leash walking. In this case, the dog is prompted to orient by calling its name and, if necessary, smooching or squeaking to gather its attention, bridging the orienting response with a click, and then prompting the dog to sit with a hand and vocal signal. As soon as the dog begins to sit, the vocal bridge "Good" is delivered, followed by a food reward. The dog should remain in the sit position until it is released with an "OK" and hand clap. The quick-sit and the recall routines (orienting response, click, come to closed hand, "Good," food reward, and release) are both practiced during slack-leash walking.

FIG. 1.16. Orientation of a dog when in the controlled-walking position.

Controlled-leash Walking and Hip-hitch

Once a dog has learned to walk without excessive pulling, a hip-hitch and control lead can be used to help develop controlled-walking skills. In addition to not pulling, controlled walking requires that the dog stay on the left side, aligning its hip with the trainer's left leg (Figure 1.16). The hip-hitch consists of a carabiner hooked under a wide bite just behind a belt loop on the trainer's left side. A longish loop of leash is tied off 1 to 3 feet away from the bolt snap, a point determined by the size of the dog. The loop is hooked over the carabiner and attached to a halter, limited-slip collar, or prong collar, depending on need and circumstances. The hip-hitch provides a consistent source of response blocking and feedback limiting the forward movement of a dog beyond the limit set for controlled walking (Figure 1.17). Excessive pulling forward is countered by stepping abruptly back on the left leg and causing the dog to turn about. In addition, the standing end of the leash or control lead running from the knot to the handle can be manipulated in various ways to provide additional control and to transition to the heeling pattern. Only experienced trainers should use a hip-hitch on large and powerful breeds with a history of

FIG. 1.17. Hip-hitch. The position of the hitch-loop knot determines the amount of action that the control lead can produce. When the loop is tied off near the carabiner, little control-lead action is possible, whereas when the knot is set closer to the to the collar, more control-lead action is available.

hard pulling. In such cases, dogs should be both hip-hitched and under the secondary control of a halter via a closed-loop arrangement (see *Halter Collars*). The hip-hitch and halter system should only be cautiously used with potentially aggressive dogs and, then, only by knowledgeable and experienced trainers familiar with the risks and techniques needed to manage and control such dogs safely. In addition to control benefits, the hip-hitch provides a means to free the hands to perform other training actions, such as squeezing a squeaker or clicker, luring and flagging, targeting, petting, and handling treats and other rewards. Controlled walking is signaled by saying "Come on" or "Let's go," and excesses are discouraged with appropriate leash prompts paired with "Easy" or "Hurry up," as needed. The dog is released from heeling to controlled walking with the signal "OK" and released from controlled walking to slack-leash walking with "OK" and "Easy" as the dog reaches the limit set on its distance to range from the trainer. Abruptly stopping and stepping back on the left foot serves to counter the dog's pulling efforts. When hip-hitched, the action causes the dog to turn about in front of the trainer, whereupon it can be guided with the left hand to the trainer's side. Before continuing the walk, the dog is required to settle and wait for 3 to 5 seconds before continuing. The procedure is used as needed to discourage pulling and to encourage more appropriate walking behavior.

Halter Training

Halter collars can be very useful for certain dogs and owners, especially children and adults who are physically unable to control a dog otherwise. The muzzling-type halter systems are particularly useful for controlling aggressive dogs and limiting their nuisance barking when on leash. When a dog forcibly lunges into the leash while wearing one of these devices, it passively turns the dog's head around while clamping its muzzle shut if the dog attempts to back out of it. To obtain the most benefit from halter training, the trainer should make a conscientious effort to positively reinforce more appropriate slack-leash and controlled-walking behavior while the dog is restrained on the halter. DeGroot, the originator of the halter for dog training, views the halter as a tool that should be used to facilitate behavior modification with minimal discomfort to the dog. She fully acknowledges the potential abuse and misuse of such devices and stresses that the halter should not be employed as a passive means to control and restrain the dog, but used in the context of well-defined training objectives. The goal of halter control is to provide the trainer with a temporary window of opportunity for enhanced reward-based training efforts so that the dog can be gradually controlled without relying on halter restraint. The powerful head-turning and muzzle-clamping effect of

the halter should not be allowed to become a way of life for the dog. The ultimate goal of halter training is to eliminate the halter (DeGroot, personal communication, 2002).

In addition to halters that exert a clamping action, fixed-action halters can be used to promote improved walking behavior. The fixed-action halter system is a versatile and effective tool for controlling excessive pulling (see Figure 1.7). The nonclamping halter has the advantage of comfort with the delivery of directive force without pinning a dog's muzzle shut. Since the fixed-action halter does not produce a muzzling effect, it is not intended or suitable for use with aggressive dogs. The design of the fixed-action halter causes pressure to be properly distributed in accordance with a dog's forward or backward movement. When a dog pulls forward, the force is directed toward the muzzle, whereas, when the dog pulls back, the force is directed to the neck loop and the back of the dog's head. In contrast, pulling back on muzzling-type halters causes the muzzle loop to clamp down on a dog's muzzle rather than primarily directing the force to the neck loop, where it is most needed for comfortable control. The muzzle-clamping action of many halter designs appears to cause some dogs a great deal of distress when they are first introduced to them. Such dogs appear to accept fixed-action halters with less resistance or struggle, making them more acceptable to concerned owners, as well. In addition to the fixed-action halter, a halter/limited-slip collar is frequently used to train adult dogs. The nonclamping, halter/limited-slip system employs both head and neck control pressure so that collar pressures are more evenly and safely distributed around a dog's neck and muzzle (see Figure 1.3). When used as a halter, it produces a very pronounced effect with a minimum of leash pressure and, since torque is distributed to both the neck and the muzzle, it can be safely used to deliver directive leash prompts. When the muzzle loop is removed, the collar becomes a limited-slip collar with a tab. In situations requiring added control, the muzzle loop can be quickly placed over a dog's nose.

Perhaps the most important consideration in halter training is proper introduction. Halters should be introduced slowly with lots of encouragement and positive reinforcement. Efforts by a dog to struggle against or remove the collar should be immediately and firmly discouraged, however. A dog should not be allowed to flail about or scrape at the collar. Such behavior should be countered with an upward leash prompt every time it occurs, followed by positive reinforcement when it stops, until the dog accepts the collar. The scent of orange oil on the hands appears to help some dogs through the transition. A few drops rubbed on the hands and placed

FIG. 1.18. Starting exercise.

directly in front of a dog's nose appears to produce a rapid reduction of distress. The fixed-action collar should be carefully fitted on a dog so that the muzzle loop is loose enough to allow the dog's mouth to open fully to pant and to take a ball, but not so loose that it falls off. The neck loop should be adjusted to fit closely around the back of the dog's head, with minimal slack or ability to slip over the dog's head. In the case of highly active dogs or dogs with thick necks, the fixed-action halter can be hitched to a nylon-slip or chain-slip collar for added security.

BASIC EXERCISES

Starting Exercise

In addition to coming and sitting in front of the trainer (sit-front), a dog should learn to go on signal to the trainer's left side and sit. The movement is prompted by tapping the left thigh and then taking the leash midway down with the left hand, whereupon one step is taken back on the left foot and the dog is gently guided around by the left hand (Figure 1.18). Initially, the trainer may need to take several steps backward or execute a heel-to-toe skipping movement to get the dog moving in the right direction. As the dog's head reaches a position just behind the trainer's left side, the trainer takes one or two steps forward, causing the dog to turn about and align squarely at the left side before it is prompted to sit. When the action is completed, appropriate social and appetitive rewards are delivered. After a moment, the dog is released with an "OK" and clap, and the trial is repeated. Once the exercise is mastered, the vocal signal "Heel" is paired with the hand and body signals used to prompt the behavior.

The starting exercise can be introduced by a shaping or luring procedure. Effective shaping depends on breaking the behavior down into simple steps. Initially, for example, any orientation or movement toward the trainer's left side is bridged and reinforced, especially movement occurring as the trainer steps back on the left foot. Next, the dog is required to follow the target hand a short distance toward the left before being reinforced. Finally, the dog is made to follow the hand around into the starting position and prompted to sit. Each step should be fully mastered before moving onto the next. A birdie lure can be effectively used to draw the dog around to the starting position (see *Targeting and Prompting*). In some cases, a resistant dog can be lured into position with a ball or a biscuit. Once the dog is moving into the starting position and sitting without hesitation, the lure is faded and replaced with the appropriate voice and hand signals. Performance reliability is enhanced with directive leash prompts, as necessary to cause the dog to move in the direction of the trainer's left side and to sit. The level of force used is determined by the dog's temperament and needs to achieve reliable compliance. Compliance to the sit command can be enhanced by pulling up on the leash while squeezing, at first gently and than progressively more firmly, across the hips just in front of the hip bones. The dog's rump should not be pushed down or slapped to increase compliance.

The dog should also learn to leave the starting position and to move forward, turn, and sit squarely in front of the trainer. The dog is guided into the sit-front position by capturing its attention, saying "Front," and taking a half-step forward with the left foot. As the dog follows, it is lured with the right hand or guided around by leash to sit in front. In addition to the left-side starting exercise, the dog should learn to go to heel by moving to the right side and then continuing on behind the trainer to the starting position on the left side. This route is typically used when the dog is located somewhere toward the trainer's right side, whereas the left-side hooking movement is used when the dog is located directly in front or toward the left side. Stepping back on the right foot signals the dog to go to heel from the right side. As the dog crosses behind the trainer, the leash is transferred from the right hand to left hand, and the dog is prompted to sit with the right hand as it reaches the starting position at the trainer's left side. The starting exercise is mastered by daily practice under varying and progressively more distracting and difficult circumstances. Also, the dog should learn to hold the position for longer periods before being released. The exercise is of tremendous

value for controlling dogs at times when increased close control is needed.

As the dog learns the starting exercise, an emphasis should be placed on requiring that it remain quiet and focused on the trainer for progressively longer periods. Sustained reinforcement lasting up to 15 to 20 seconds can be useful in the beginning to help keep the dog's attention in focus. Likewise, the trainer should take a moment to formally dress the leash, breathe, and concentrate on the dog and the training objectives, thereby joining the dog in the same moment of heightened attentiveness and appreciation. In the Japanese tea ceremony, the phrase *izumai o tadasu,* literally meaning to straighten one's kimono or posture, is a ritual preparation occurring in advance of preparing and serving tea, signifying an appreciation and respect for the guest and attentiveness to the moment shared with the guest in the making and taking of tea. A similar significance should be nurtured with regard to the starting exercise. As the dog comes to the trainer's side and the leash is carefully dressed, the trainer should collect the moment with an attitude of affectionate respect and appreciation for the dog's compliance and cooperation in the process of attaining interactive harmony.

Lying Down from the Sit Position

With the dog sitting in the starting position, the trainer changes leash hands and shifts in place about one-eighth turn toward the dog. The left hand (now holding the leash) is placed on the dog's shoulder and the thumb is hooked over the collar as the trainer crouches down. At the same time, the right hand is extended just in front of the dog's nose and moved downward toward the ground. As the result of the introductory lessons previously described, many dogs will naturally follow the hand's movement and lie down without hesitation. As the dog lies down, the bridge "Good" is spoken in a high-pitched tone, followed by a treat and sustained petting and massage once the dog assumes the down position. As the trainer stands upright, the left foot is placed over the leash so that the dog cannot prematurely break the down position (Figure 1.19).

The trainer should avoid pressing down on the dog's shoulder, since this may cause the dog to resist and push upward against the pressure. Lying down can be shaped through successive steps (e.g., targeting on the hand, following the hand as it moves downward, following the hand down to the floor and, finally, following the hand and lying down). Each approximation is bridged and reinforced and repeated as necessary to obtain a fluent response. In some cases, a toy or biscuit can be used as a lure to facilitate the response. The lure is kept just beyond the dog's reach as it is lowered to the ground. As previously discussed, food lures often function as a bribe; that is, luring the dog with a biscuit risks reinforcing its initial unwillingness to lie

FIG. 1.19. Down exercise.

down. In a sense, the dog's refusal to lie down may be calculated to manipulate the owner into bribery. As the result of success in such efforts, the dog may quickly learn that hesitating when prompted to lie down causes the owner to offer a bribe—a pattern that the dog is only too willing to reinforce! Habitually giving the dog the biscuit after luring may lead it to hold out and refuse to perform the response unless the bribe is in hand. A useful technique for fading the lure is to close the hand as though it might contain the biscuit when giving the down signal. After the dog is rewarded, it is either released with an "OK" and clap or prompted to perform another exercise from the down position (e.g., down-stay). Once the dog is lying down rapidly and consistently in response to the hand signal, the vocal signal "Down" is paired with it. As the trainer stands up, the leash is stepped on to prevent the dog from getting up. Down is practiced in a variety of situations and contextual relations to other basic modules and routines (see Appendix B.1).

In the case of dogs that refuse to lie down despite conscientious reward-based shaping and luring efforts, the following procedure can be useful for improving compliance. The slack of the leash is dropped to the ground and stepped on with the left foot. Next, the working slack is pulled out of the leash as the left foot is angled up 3 or 4 inches, with the heel planted on the ground as a point of leverage. The down signal is given and the foot is lowered to the ground, placing pressure on the dog's neck and forcing it to lie down. If necessary, the force is increased by repeating the procedure, causing additional leash to be taken up and producing a ratcheting effect that gradually compels the dog to lie down. In some cases, squeezing across the neck muscle at the withers, gently at first and than more firmly as needed to prompt the down response, can further enhance compliance when combined with the ratcheting procedure. Forceful stamping on the leash should be avoided in favor of more controlled and measured techniques.

Sitting from the Down and Stand Positions

The dog is prompted to sit from the down position by first rocking or shuffling slightly forward on the right foot and then, as the dog begins to get up, stepping back on the left foot and, with an upward movement of the right hand, signaling the dog to sit. As the dog sits, the response is bridged and reinforced. Next, to prompt the dog to stand from the sit position, the trainer dresses the leash across the left knee and then takes one step forward into the leash with the left foot. The step forward prompts the dog into the stand position, and the response is bridged and reinforced. As the dog stands, the trainer gently restrains the dog with the left hand on the collar so that it does not move too far ahead. If the dog attempts to sit, an additional step is taken—a procedure that is repeated together with a slight downward pressure applied by the palm or fingertips of the left hand to the dog's shoulders. The slight downward pressure causes the dog to push back, thereby competing with its tendency to sit. Once steady, the dog is released with an "OK" or prompted to sit. The dog should be required to hold the stand-stay at the trainer's left side for progressively longer periods. Once the basic response is established, the vocal signal "Stand" is paired with the step forward. The reliability of stand response is gradually improved by the practice of routine variations (see Figure B.1C in Appendix B). As the dog's training progresses, sit responses occurring in association with recall and sit-front, starting and finish exercises, and heeling are often encouraged to occur automatically (see *Automatic Sit*), requiring that vocal and hand signals controlling the sit response be gradually faded. Consequently, the vocal and hand signals prompting the sit response are primarily practiced for enhanced reliability in the context of controlled and slack-leash walking, stand, and down training (see Figure B.1A–C in Appendix B).

Integrated Cycle of Basic Exercises

The basic obedience repertoire consisting of the stand, sit, down, sit from the down, and stand from sit modules is practiced as a chain of interconnected routines in order to enhance the fluency of each step and to establish a balanced and reliable pattern of performance. Not only should these routines be

performed in the normal forward and reverse orders, they should also be practiced in various unexpected ways as the dog's skill and proficiency improves (see Figure B.1D in Appendix B). All the basic exercises are integrated with the stay and heeling pattern. As the dog's training progresses, the reinforcement schedule is varied so that the dog might be required to offer a series (twofers and threefers), such as sit and stand (a twofer) or down, sit, and stand (a threefer) for the same reward. Although food is given intermittently, each successful effort should receive appropriate bridging and affectionate encouragement.

Stay Training

All basic exercises are performed with an implicit stay; that is, a dog should remain in the position until it is released ("OK") or prompted to perform another module or routine. It is particularly important not to allow a dog to break the position immediately after receiving affection or food rewards.

Stay from the Starting Position

The sit-stay exercise is practiced by calling the dog by name, saying "Stay," and stepping off on the right foot, whereupon the left hand is swung back to take up the leash, and the trainer turns to face the dog momentarily. As the trainer turns, the working end of the leash is dropped. The remaining standing slack is let out as the trainer steps back, with the right-hand flag (palm out and held at chest level) toward the dog. The handle of the open leash hangs from the right thumb as the trainer steps back a few steps. Once at the end of the leash, the leash handle is changed from the right thumb to the left thumb, with any excess leash slack taken up into a single fold in the left hand. Finally, the right hand is placed over the left hand at waist level. If the dog attempts to move out of position, the trainer prompts the dog back into position or returns it to the original position.

The trainer goes back to the dog by retracing previous steps or by circling behind it. If the trainer opts to go around the dog, the open leash is flipped onto the dog's right side as the trainer starts around the dog's left side. The leash is gathered and dressed as the trainer returns to the starting position at the dog's right side. At the conclusion of the exercise, the dog is either released with an "OK" and clap or reinforced and prompted to perform some another task; the dog is never permitted to break a stay without a signal (See Appendix A).

Most dogs rapidly learn to stay. However, some highly excitable ones may require vigilant handling, response blocking, and directive prompting to control. Frequent or sustained reinforcement can be a highly effective means to initially encourage excitable dogs to stay and focus on the trainer. Well-timed vocal or leash prompts can prevent dogs from breaking the position and provide an additional opportunity for reinforcement. If a dog breaks the position altogether, it is returned to the original spot and the exercise is repeated. An active-control line (ring or post) can be used to facilitate stay and recall training via response blocking and reward training. The down-stay and stand-stay are practiced in a similar way as the sit-stay. Directive procedures and blocking are minimized by gradually establishing stay routines in small well-mastered steps. Stay training consists of eight separate but interrelated criteria, each requiring explicit training:

Criterion 1 *Duration:* The dog is required to stay for progressively longer periods while the trainer stands nearby or just out in front. As the trainer's distance away from the dog increases, additional duration criteria are added in advance of every increment of distance. Reliability associated with duration is the most important foundation or anchor of stay training. The duration phase of stay is associated with training the dog to hold eye contact with the trainer for progressively longer periods. Once a standard expectancy (see *Prediction and Control Expectancies*) is established, variations with respect to the frequency of rewards and the duration of the stay period can be used to help strengthen the stay exercise. During the early stages, the dog is given frequent rewards while its stays, learning only to move out of position after it is release with an "OK" and hand clap. Since the stay exercise is mildly aversive for most dogs, providing a dog with varied and highly valued rewards can be helpful, as can the

surprise generated by periodically releasing the dog sooner than normal.

Criterion 2 *Differentiation:* Differentiation refers to the systematic association of different basic exercises with stay training, until they are all equally steady and reliable, both as discrete modules (e.g., sit, stand, and down) and routines (e.g., sit from the stand, down from the sit, sit from the down, and stand) and as dynamic exercises (e.g., the walking stand-stay).

Criterion 3 *Distance:* Once the dog is holding the sit-stay, down-stay, and stand-stay for 30 seconds or so, the trainer increases the distance criterion by gradual increments. In the context of increasing distance, further differentiation and organization of basic modules and routines are continued while introducing and practicing distance exercises (e.g., sit from the stand, down from the sit, sit from the down, and stand), performed in conjunction with the walking stand-stay exercise. Initially, the trainer prompts these exercise at a distance of a step or two away from the dog, then at the end of the leash and at the end of the long line, and finally with the dog off leash (see *Walking Stand-Stay and Distance Exercises*). Practicing the recall from the sit, down, and stand-stay should be added only after a high degree of control is established over the distance exercises. Calling the dog from the stay should be calculated to produce surprise, thereby strengthening the stay and giving enthusiasm to the recall. With each step of increasing distance and differentiation, additional training and proofing of criterion 1 should be carried out, especially with respect to the proofing of the down-stay. With the trainer at a full leash distance, the dog should be reliable in a down-stay for a minimum of 1 to 3 minutes, 3 to 5 minutes at a long-line distance, and 10 minutes or more when off leash. Recall from the stay is practiced in the context of developing an interruption signal that causes the dog to stop after starting to come, to wait, or immediately to drop before being called to front and finish.

Criterion 4 *Direction:* The dog should be left to stay with the trainer walking away in various directions, for example, stepping off to the side, stepping back, stepping toward the front, and sharp turns off to the left or right. When introducing directional variations, further differentiation and reliability of basic exercises is achieved by having the dog sit, stand, or lie down from various distances, directions, orientations (e.g., facing away from the dog), and locations relative to the dog.

Criterion 5 *Difficulty:* After the dog is staying reliably at a long-line distance, various elements of difficulty are added with the dog both close by and at various distances. Additional difficulty can be introduced by leaving the dog in unusual directions and ways and doing things out of the ordinary while the dog is in the stay. For example, the trainer can crouch down or sit on the ground, walk around the dog, run by the dog, fall down, roll over, rush toward the dog, or step slowly toward the dog. Additional difficulty can be added by leaving the dog's sight (e.g., hiding behind a tree or going around the corner of building).

Criterion 6 *Diversification:* Stay is integrated into everyday activities requiring that the dog stay or wait before getting what it wants, e.g., wait before being released to fetch a toy, before getting into a car, before being permitted to jump onto furniture, and before being let outdoors. With the transition to the long line, the dog should learn to halt and stay when chasing a throw-away object (e.g., a stick or other object of no critical significance to training objectives). After giving the dog a stay command, the object is thrown and, if the dog chases after, it the command "Stay" is shouted as the trainer tamps or stamps on the long line. The dog should wait in place until the trainer recalls it or releases it to retrieve the object. The halt-and-wait response is a critical preliminary to off-leash training (see *Using the Long Line*).

Criterion 7 *Diversions:* After the dog is solid under the foregoing circumstances, increasingly distractive situations are identified to proof the dog's ability to stay in the presence of attractive diversions (e.g., children playing, wildlife, other dogs, joggers, and bicyclists) while on leash and long line. The trainer can bounce a ball with the dog in a stay exercise, finally releasing the dog to chase or catch the ball. The quick-sit and instant-down are introduced in the context of prov-

ing the stay under highly distracting conditions.

Criterion 8 *Disruptions:* In addition to attractive diversions, the dog is also gradually exposed to potentially startling or aversive events with appropriate counterconditioning and graduated exposure, as needed to reduce its reactivity (e.g., traffic and loud noises) while practicing stay variations.

Stop, Stay, and Come

Occasionally, while walking on a slack leash, the dog is signaled to "Stay." If the dog hesitates and stops, the trainer should immediately bridge the behavior and approach the dog in a reassuring way, reward it, and release it with an "OK" and clap. If the dog fails to stop, the trainer anchors the leash on the waist with both hands and abruptly stops, thereby bringing the dog to a sudden halt. Besides learning to stop and wait while walking on a slack leash or long line, the dog should also learn to come when called and to sit-front. The trainer calls the dog by name, says "Come," and delivers a hand signal consisting of a sweeping action of the right hand moving across the chest. If the dog responds, the behavior is bridged with the clicker or vocal reward "Good," and the dog is directed to sit directly in front of the trainer. Taking a few steps backward as the dog approaches the trainer can help to facilitate straight sits. Finally, the dog is prompted to finish with the command "Heel," whereupon it should sit automatically. The dog is appropriately rewarded and released to repeat the exercise.

Quick-sit and Instant-down

The quick-sit involves training the dog to sit rapidly without hesitation, regardless of the dog's disposition or environmental circumstances. The quick-sit is an emergency exercise that signifies that the dog must stop whatever else it is doing and sit immediately and remain still until it is released. The quick-sit should involve a foundation of intensive reward-based training and directive enhancement, as needed to achieve a high degree of reliability under diverse and progressively distracting and difficult environmental conditions. The quick-sit is proofed in the context of intensive stay training. Like the quick-sit, the instant-down is a rapid and immediate emergency response. The dog is required simply to drop in place without hesitation. The module is introduced only after the dog is fluently lying down from a sit position. The first step involves training the dog to lie down from the stand. This task is facilitated by first training the dog to bow by targeting on a hand moving toward the ground. Once the dog is bowing on signal, instant-down while walking or heeling is much easier for it to perform. The task is prompted by turning slightly toward the dog and directing it with an excited tone of voice and downward hand signal to drop to the ground. If the dog fails to respond, the trainer lures or physically prompts the dog into the down position. As the dog complies, the behavior is bridged and reinforced, but the dog should continue to hold the down-stay until it is released. If the dog attempts to get up, the trainer stands on the leash with the left foot. At the conclusion of the exercise, the dog is either released, prompted to sit or stand, or walked out of the down position, depending on what is appropriate given the situation. This exercise is repeated several times in close succession until the dog learns to drop without hesitation. The instant-down can be facilitated with a ball lure and play following compliance.

Go-lie-down

Training dogs to go to a specific place and to lie down is a valuable exercise that all companion dogs should learn and regularly practice. The behavior consists of the dog leaving the proximity of the trainer or stopping some activity, moving to a designated spot, and lying down. This sequence of behaviors is first shaped using positive-reinforcement techniques. Training the dog to go lie down assumes a reliable and fluent down and instant-down response. Initially, the dog should be trained to go to a rug by using a shaping process. One way of accomplishing this is by using a clicker and shaping the routine via a series of approximations that train the dog to go to the rug, lie down, and stay there (Table 1.2). Once the dog is going rap-

idly to the rug or bed and lying down, the response is generalized to other places and contexts involving increasing distractions and difficulty (e.g., the presence of a guest or while the family is eating). Tossing a soft toy toward the spot where the dog is expected to lie down may help it to follow the pointing prompt. If necessary, the dog can be lured or ushered part of the way and then prompted to the spot by pointing and saying "Go." As the dog nears the spot, the command "Lie down" is given, and a treat is tossed to the dog as it lies down. Once the pattern is established, the whole command is given at once, "Go lie down," coupled with a pointing prompt toward the spot.

FIG. 1.20. Heeling position.

HEELING

In addition to slack-leash and controlled walking, dogs are trained to walk at heel. Formal heeling is a valuable lesson for every dog to master. When heeling, a dog remains close at the trainer's left side, without crowding or interfering with the trainer's movements. The leash is held in the right hand and dressed across the left knee. When the dog is heeling in the proper position, the working end of the leash intersects the trainer's line of movement at a 90° angle; that is, the dog is squared up at the trainer's side when heeling, neither moving past nor lagging behind this reference point (Figure 1.20). Heeling is an exacting activity, with a mere inch or two of deviation out of the position representing a flaw needful of adjustment. A close approximation is not enough, the dog is either heeling or not. There is a groove that is hard to describe but known to anyone who has trained a dog to

TABLE. 1.2. Shaping contingencies for the go-lie-down response

Step 1:	Turn away from the trainer
Step 2:	Turn away and orient in the direction of the rug
Step 3:	Move in the direction of the rug
Step 4:	Move with hand signal in close proximity to the rug
Step 5:	Move in close proximity to the rug and wait for reward
Step 6:	Pair hand signal with "Go," touch the rug, and wait for reward
Step 7:	Stand halfway on the rug and wait for reward
Step 8:	Stand fully on the rug and wait for reward
Step 9:	Hand and voice signal "Go lie down," go to the rug, wait, and down on hand signal before reward is delivered
Step 10:	Go to the rug, lie down on signal, and wait for reward
Step 11:	Go to the rug, lie down (signal faded), and wait for reward
Step 12:	Go to the rug, lie down, and wait to be released before receiving the reward
Step 13:	Go to the rug, lie down, and stay for a variable length of time before being released
Step 14:	Specify different locations to lie down by vocal and directional cuing

walk squared up at heel. Although the heeling position can be defined as a geometric relationship, in reality it is more a state of mind shared by the trainer and dog. Properly understood and performed heeling is a moving meditation during which the dog and trainer *join* in an attitude of cooperative purpose and heightened awareness of each other.

Again, the importance of preliminary training using a shaping procedure and play-based luring cannot be overemphasized. The trainer should always strive toward making training efforts as affectionate and rewarding for the dog as possible. Shaping a heeling pattern is introduced in a relatively distraction-free environment. The trainer attracts the dog's attention and encourages it to orient toward the left side, whereupon the approximation is bridged and the dog given the reward after it comes to the trainer's left side and sits. Sustained reinforcement helps to strengthen an impression that the left side is a desirable place to be. Using a licking stick slathered with peanut butter is one way to deliver sustained reinforcement while the dog is walking or sitting at the trainer's left side—a method that can be useful in the context of counterconditioning fears where sustained appetitive arousal is needed. With every occurrence in which the dog orients on the left side, a bridging signal is followed by a prompt to sit, "Good," and food reward. To make handling the various paraphernalia less cumbersome, the dog can be kept on a hip-hitch, thereby freeing the hands to signal, lure, and reward its behavior. Alternatively, the dog can be worked on a loose leash dragging on the ground or, in the case of more active dogs, a long line that is controlled by stamping actions. The usual pattern is to encourage the dog to orient and walk closely at the left side of the trainer before bridging and rewarding the behavior. By crouching down, turning about, running ahead, making various lip and squeaker sounds, and otherwise attracting and keeping the dog's attention, it will be more willing to play along and follow. Attracting the dog with a ball, luring it to the left side, and encouraging it to walk closely with right turns and right about-turns and changes of pace before allowing the dog to tug or fetch the ball can be a highly effective and fun way to introduce the concept.

Although play and reward-based training is a desirable way to introduce some of the basic elements, heeling as a formal activity is rarely fully attained without some element of directive training, as required to control the influence of distractions on a dog's wavering attention and impulse control. However, by carefully preparing the dog with preliminary play and reward-based training activities and making heeling a fun thing to do, the dog is certain to require far fewer and less forceful prompts than would be otherwise necessary to control its attention

Major Faults

At the beginning of every walk, dogs should always be given the liberty to walk at ease on a slack leash or long line, giving them a moment to relax and eliminate, if necessary. In the case of highly excitable dogs, ball play can be a useful way to dissipate excess energy. Once a dog is walking without pulling, it is called to the starting position at the trainer's left side and prompted to sit. The leash is dressed and, after a brief moment of affectionate praise and petting, the trainer gathers the dog's attention with its name and the command "Heel" and steps off on the left foot, slapping the left thigh, and smooching and clucking as needed to attract the dog's attention. If the dog forges out in front, the trainer drops the leash slack and turns away from the dog. As the turn is made, the left and right hands are drawn together and anchored near the left hip. The right hand is closed firmly around the leash handle, while the left hand is held open with thumb forming a crook over the leash. If the dog lurches to the side instead, the trainer turns sharply to the right. When applying directive prompts, the leash should be adjusted up or down on the thigh to keep it level with the line of the dog's back. Careful timing is crucial; if the slack of the leash is taken up too soon or too late, the effect is diminished or lost. The collective movement of the shoulders, hips, arms, and legs are coordinated to join up just as the dog gets to the end of the leash. As the dog turns and follows, the trainer should continue walking in the opposite direction for a few steps before resuming the original direc-

tion. As the dog follows along, its behavior is appropriately bridged and reinforced, with the trainer periodically stopping and prompting the dog to sit and rewarding it with affectionate praise, petting, and food.

Minor Faults

As dogs learn to stay back, changes of direction and leash prompts are used to refine the heeling pattern further. Now, instead of dropping the standing slack, the working slack is used to generate the appropriate directive prompt. A closer approximation to the proper heeling position is obtained by making left quarter-turns and about-turns into the dog. The left turn is made by taking up the working slack of the leash with the left hand, pivoting slightly on the left foot, and turning into the dog with the right leg. Short grab-and-release leash prompts delivered with the left hand can be used to improve slight out-of-position faults. Although such corrections are useful for polishing purposes, a broader brush is needed during the early stages of training, during which the left hand should refrain from holding the leash unless a directive prompt, left turn, or stop-sit prompt is being performed. To function efficiently, the change of behavior produced by the directive prompt should be bridged and reinforced with food and social rewards (praise, petting, and play).

Lateral lurching from the heeling position is corrected by turning to the right. This maneuver simultaneously exaggerates the fault (thereby making it more explicit and evident to the dog) and corrects it. Balking and lugging are corrected by dropping the standing slack and walking into the leash, combined with enticement actions (clucking, smooching, leg slaps) and vocal encouragement. Lunging is discouraged with brisk changes of pace and efforts to enhance the dog's performance motivationally with increased positive reinforcement and play. Stepping back abruptly into the leash with the right leg and then forward again on the right leg effectively discourages the dog from crossing behind the trainer. The various left and left-about turns, right and right-about turns, and changes of pace serve to zero the dog in on the heeling position. Throughout the training process, heeling should be continuously reinforced with vocal rewards and mechanical bridging, petting, play, and varied food treats.

Heeling Square

The quality and accuracy of the heeling pattern is gradually improved by employing various changes of pace (slow, normal, and fast) mixed with turns, directive prompts, bridging, and reinforcement. A heeling square can be used to refine and polish the heeling performance. The square can be indicated either with corner markers or by simply keeping the shape roughly in mind as one counts off steps from corner to corner. With the dog positioned on the outside of the square, the trainer says "Heel" and steps off on the left foot. After 6 to 10 steps, a sharp 90° right turn is made; this right turn is repeated three times, bringing the dog back to the starting point. As each turn is made, the trainer slaps his or her left thigh to draw the dog's attention, followed by appropriate encouragement and affectionate praise, as the turn is completed. Once back at the starting point, the trainer turns about so that the dog is now located on the inside of the square, and the dog prompted to sit and is reinforced. From this orientation, the dog is heeled around the square in the opposite direction by making a series of left 90° turns. Just before each left turn, the trainer picks up the working slack with the left hand, pivots slightly on the left foot, and steps in front of the dog with the right leg to complete the turn. As the square is completed in both directions, the trainer orients the dog toward the opposite corner of the square before prompting it to sit. The dog is walked at heel along the diagonal line between the corners and alternately prompted to make left and right about-turns. As each turn is completed, the trainer changes pace, saying "Easy" before slowing the pace or "Hurry" before speeding it up. After left and right about-turns with changes of pace, the dog is heeled around an imaginary circle traced within the square. The dog is first directed to heel around the square in a clockwise direction and then in a counterclockwise

direction. Walking clockwise requires the dog to walk slightly faster to keep up at the trainer's side, whereas walking counterclockwise requires the dog to slow down to stay properly aligned. At the conclusion of the foregoing variations, the dog is walked in a spiraling direction toward the center of the square, where it is left in long down-stay. After a variable period of 1 to 3 minutes, the trainer returns to the dog, releases it with an "OK" and clap, and engages it in ball play.

Automatic Sit

When walked at heel, a dog should sit whenever the trainer comes to a stop. In addition to sitting automatically while heeling, the dog should also learn to sit automatically after starting and finishing exercises and when called to sit front. The trainer's intention to stop is communicated to the dog by taking up the leash with the left hand and making a pulsing movement two or three steps before stopping. The slight movements of the leash announce the trainer's intent to stop, thereby preparing the dog to stop in unison with the trainer and to sit neatly at the left side. As the dog sits, the response is bridged and rewarded; if the dog the fails to sit, however, the trainer prompts the response with a hand signal, shadow, or knee bend and directive prompt. Crooked or awkward sitting is most easily adjusted or prevented by prompting the dog to adjust before it completes the action. If the dog begins to sit crookedly, it can be lured into the proper position or walked a step or two forward before being prompted to sit again. Alternatively, the dog can be prompted to perform the starting exercise before being prompted to sit straight. Attentive heeling in a proper alignment with the trainer prevents or solves many problems associated with crooked or awkward sits.

Interrupting the Automatic Sit

When walked at heel, a dog is obligated to sit automatically whenever the trainer stops. However, the trainer may prefer on some occasions that the dog not sit but stand still and wait instead. With such considerations in mind, an interruption signal is introduced that serves to set aside the obligation to sit and sets the occasion for the dog to stop and stand still instead. The automatic sit is interrupted with the vocal signal "Stand" while touching or gently pushing on the dog's shoulders or the back of its neck after coming to a stop. This stand prompt has been previously used to help the dog learn to stand from the sit or down position. If the dog begins to sit, the trainer repeats the command and takes an addition step forward on the left foot. The dog rapidly learns that a light touch on the shoulder or neck signifies that it should not sit, whereas the absence of such a signal by default indicates that it must sit automatically when the trainer stops.

Releasing the Dog from the Heeling Pattern

Proper heeling requires focused attention and the exertion of tremendous impulse control by a dog. Although it is beneficial and useful for a dog to learn how to heel, it is not beneficial to force a dog to heel all the time. Most dogs have so little opportunity to go on walks that it is only fair that such opportunities be made as cheerful and pleasant as possible for them, without the owner being towed around by an out-of-control dog. Normally, dogs should be walked on a controlled or slack leash 80% to 90% of the time and be brought to heel at times when more control is needed or as a means to discourage undesirable walking behavior. In accordance with the Premack principle (see *Premack Principle: The Relativity of Reinforcement* in Volume 1, Chapter 7), releasing a dog from the heeling position to controlled-leash or slack-leash walking can be used to reinforce good heeling habits. Consequently, it is best to release the dog while it is heeling nicely without pulling, sniffing, or looking around, whereas the dog is called back to heel when it becomes difficult to control while walking on a slack leash. Moving from walking the dog on a slack leash to a heeling pattern is mildly annoying and can serve to discourage undesirable walking behavior. After a period of heeling, the dog is again released and periodically reinforced for walking without pulling with appropriate bridges, treats, and opportunities to play. The

dog is released from heeling to controlled walking by saying "OK," changing leash hands, and flipping the slack leash onto the dog's back. The trainer releases the dog from controlled walking to slack-leash walking by saying "OK" and letting the slack slide out between the thumb and index fingers. When the appropriate amount of leash has been let out, the trainer says "Easy" and pinches the leash, thereby setting the distance given to the dog. The dog is brought to heel from slack-leash walking by transferring the leash from the left to the right hand, calling its name and "Heel," and delivering appropriate hand signals and leash prompts. With the left hand guiding the leash, the dog is prompted to turn about and come up sharply and squarely into the heeling position. Depending on specific needs, the dog is either allowed to sit automatically or directed to heel forward with the leash dressed neatly across the left knee.

WALKING STAND-STAY AND DISTANCE EXERCISES

The walking stand-stay is performed with the dog heeling at the trainer's left side. The exercise is initiated by saying, "Stay" and then sweeping the left hand back and taking up the leash, whereupon the trainer pivots slightly on the left foot before turning and stepping sprightly in front of the dog. As the trainer turns about, the leash slack is dropped, and the stay flag is presented to steady the dog as the trainer backs away from the dog. The exercise is practiced with the goal of training the dog to stop in midstride with the vocal and hand signals.

The walking stand-stay is introduced in the context of practicing distance exercises, including sit from stand, down from sit, stand from sit, down from stand, stand from down, and the recall routine. These various exercises are practiced at a half-leash and a full-leash distance away from the dog. As the behaviors are mastered, they are practiced with the dog on the long line and finally with it off leash. Sitting from the stand-stay is prompted by saying "Sit" and then sweeping the right hand upward to a point just below shoulder level. The down is prompted with the dog in the sit position by saying "Down," followed by a downward sweep of the right hand. Hand signals are delivered while taking a half-step on the right foot in the direction of the dog. The stand exercise is prompted from a distance by saying "Stand," together with a hand signal presented by shifting the right hand, palm down, first toward the dog and then bringing it back toward the hip. As the right hand is pulled back toward the hip, the trainer takes a half-step back on the right leg. As the dog moves into the stand position, the stay flag is presented with a step toward the dog to prevent it from moving out of position. If necessary, a stamping action is included to discourage forward movement by the dog when it is prompted to stand. Finally, the dog is recalled by calling its name and saying "Come" as the right hand is swept across the chest. The recall signal is also performed with a half-step back on the right foot. The forward and backward half-steps

FIG. 1.21. Active-control line with carabiner and webbing.

used to introduce distance exercises are gradually faded and then used only in situations requiring additional emphasis. When hand signals are presented, the fingers of the right hand should be held together, and the signal is performed neatly and consistently. Once the dog responds reliably to the vocal and hand signal combinations, the repertoire of basic modules and routines is practiced with vocal and hand signals presented alone. These various body and hand movements are also used in association with prompting delivered at a distance via the long line. In some cases, distant exercises are introduced with the dog on an active-control line (ring or post), thereby giving the trainer added control over the dog's forward movement (Figure 1.21).

The stand, sit, and down modules are practiced in various sequences and routines to promote balance and to prevent anticipatory responding. After the completion of each trial, the trainer should return to the dog to deliver rewards and initiate another trial or to release the dog. Distance exercises can be practiced in routines consisting of two or three modules at a time before returning to the dog. These basic exercises should be practiced under a variety of conditions of increasing distraction and difficulty. The recall sequence can be performed intermittently in the context of practicing distance exercises. However, repeatedly calling a dog from the stay after completing some exercise may cause the dog eventually to start breaking in anticipation of being called. Consequently, the dog should be called infrequently while organizing distance exercises and projects. The recall is practiced with the dog in sit-, stand-, and down-stay positions. Figure B.1A–D in Appendix B contains several sets of practice variations that are gradually introduced in accordance with the dog's training level. The variations are practiced in groups defined in terms of the dog's specific training needs. It is not necessary to practice all of the variations during the same session (practice may be limited to repetitions involving three to five variations per session), nor is it necessary to follow the particular order in which the practice modules and routines as are listed. These various exercises are practiced at progressive distances from the dog on a long line and off leash, as the dog's reliability permits.

Recall Training

No training project is more important than training the dog to come reliably when called. All companion dogs, but especially dogs exhibiting problem behaviors when off leash, should be trained to come and halt-stay to a high degree of proficiency and reliability. The habit of coming when called should be established early and practiced often. Puppies not trained to come when called before week 16 are typically much more difficult to train to come reliably as adults. Early training efforts should emphasize reward and play training, thorough environmental exposure and habituation, and varied daily practice activities. An unwillingness to come is most often the result of the combination of neglectful training and interaction that inadvertently trains the dog not to come when called. One of the most common mistakes leading to adult recall problems involves chasing a puppy that refuses to come or delivering punishment after catching or trapping a puppy on the run. Such interaction invariably promotes expectancies antagonistic to the development of a reliable recall. Another source of conflict and tension involves calling the dog from highly rewarding activities to less rewarding outcomes.

For instance, a dog that is kept indoors in a crate for the majority of the day often finds opportunities to go outside very exciting and enjoyable. Calling the dog back inside before it is ready demands that it give up a highly rewarding circumstance in exchange for a much less rewarding one. In this case, it would be more constructive to have the dog stay at the door and then to call it to come outside. After the dog has gotten its fill of the outdoors, its desire to come back inside will naturally improve, especially if strong incentives to do so are presented at such times. When the dog must be called from a highly rewarding situation to a less rewarding one, two methods are usually recommended: (1) The trainer goes to the dog and secures it without calling it. (2) If the dog must be

called, a 45-second period of diversionary activity and reward is provided (e.g., affection, treats, and ball play), thereby producing a buffer between the act of coming and a potential loss of reward.

Along these lines of inadvertent punishment, a common mistake is to call a dog to its crate. Crate restraint is far from pleasurable for most dogs and puppies (see *Dangers of Excessive Crate Confinement* in Chapter 2). The overall effect of calling a dog to crate confinement is to arrange a long exclusionary TO with restraint to occur when the dog comes, hardly an incentive to come when called in the future. In addition to being intrinsically aversive to the dog, the timing of crate confinement often signifies that the owner is about to leave the house, further increasing aversive associations with coming. Habitually calling a dog in order to confine it may result in its learning behaviors that are actively antagonistic to coming when called at other times, including the development of chase-and-evade contests when outdoors. Such activities are exciting, fun, and rewarding for dogs, serving to further reward the dog for not coming when called. Lastly, a poorly informed or impatient owner might fall into the foot-shooting habit of calling the dog to the site of a house-soiling or chewing incident in order to deliver a belated dose of punishment. Not only is such treatment ineffectual for producing the intended effect, it will strongly decrease the dog's future willingness to come when called, as well as adversely affect its trust in the owner.

Behavior shaped through positive reinforcement alone is reliable only to the extent that the dog is willing to work for the rewards offered by the trainer. In the case of food and petting, this readiness fluctuates widely depending on the dog's motivational state. Another important factor affecting the reliability of behavior shaped through positive reinforcement is the influence of extraneous contingencies of reinforcement (see *Distractions: Competing Sources of Reward*). For instance, a dog might find chasing a squirrel into the street much more intrinsically rewarding and immediately gratifying than anything the owner has to entice it to stay or to come. In this example, the opportunity to chase a squirrel may be more exciting and reinforcing than rewards controlled by the trainer (e.g., petting, food, and play). The learning theorist E. R. Guthrie (1938/1962) has nicely summarized some of the more important elements and pitfalls of recall training:

> A careful trainer follows the instructions to be found in an army manual: Never give a command that you do not expect to be obeyed. The reason for this is, of course, that a command that is followed by disobedience becomes an associative cue for the disobedient action. To train a dog to come when his name is called, the dog must first be induced to come. This can be done in various ways, and it is in his knowledge of these ways that the man who knows dogs shows his superiority. But whether he shows the dog food, or pulls the dog toward him with a check line, or starts away and trusts the dog to follow, it is the repetition of the name as the dog starts to approach that establishes the name as a cue for approach … To undo this training all that need be done is for the trainer to do as many owners do, call the dog's name while he is preoccupied with something else, or just as the dog starts off to chase a car, or in any circumstances in which the dog could not be expected to obey promptly. The name then becomes a cue for this particular form of disobedience and loses all its drawing power. (41)

Guthrie's observations are reminiscent of Thoreau's pithy journal comment: "When a dog runs at you, whistle for him." As a general rule, a trainer should never call a dog unless confident that the dog will comply or, if it fails to respond as expected, the trainer has adequate means at his or her disposal to ensure compliance. Calling the dog when one is uncertain of its compliance flirts with introducing a highly undesirable lesson, training the dog that it can sometimes escape the obligation to come when called, especially when under the influence of a highly motivational state. Ultimately, such training may teach the dog that the vocal signal "Come" signals an exciting opportunity for it to safely run away. Also, the trainer should avoid misusing the dog's name as a recall signal or reprimand. In obedience training, the dog's name should be used only to capture and control its attention—not as an alternative recall signal (Table 1.3).

TABLE. 1.3. Common activities that are counterproductive for reliable recall habits

Avoid chasing or cornering a dog that refuses to come. No advantage is derived from this effort, except perhaps in an emergency situation where no other alternative is available.
Never punish a dog that finally comes after at first hesitating or refusing to come when called.
Avoid calling a dog unless it is virtually certain that the dog will comply or that appropriate means are available to enforce the command should the dog fail to comply.
Avoid bribing or threatening. Whereas bribes reinforce the undesirable behaviors that prompt the bribes in the first place, threats are doubly inappropriate: they remove any positive incentive for the dog to come while at the same time revealing that the owner is unable to deliver on threats, so long as the dog remains at a distance.
Avoid repeating commands: repeating commands tends to associate the signal with behavior incompatible with coming when called. When running off, a dog is typically running toward something that is more rewarding at the moment than the owner. Calling a dog to come at such times may only serve to train the dog to run away on cue.
Whenever possible, avoid calling a dog from a highly rewarding activity to a less rewarding one.

One of the most challenging problems faced during off-leash training is training dogs to desist from running off after moving distractions, such as cars, bicyclists, runners, wildlife, or other dogs (see *Distractions: Extraneous Sources of Reward*). In addition to inhibitory training, proofing a dog while around such sources of stimulation is achieved through graduated exposure and counterconditioning—objectives that are facilitated by making use of a long line (see *Leash and Long Line*). The 30- to 50-foot long lines help to approximate off-leash conditions without totally relinquishing control over the dog. The dog should be given a certain fixed *search limit* that it must learn to avoid exceeding by turning back or by waiting for the trainer to approach from behind. The behavior of following, moving out, turning, and coming back (the search chain) is an innate tendency in most dogs. However, dogs not exposed to off-leash walks early in life may not show search-chain behavior, possibly because some window of opportunity or sensitive period for its expression passed in the absence of appropriate allelomimetic stimulation. In any case, as the dog reaches the limit of its range, the trainer should call its name (perhaps whistling or clapping if necessary to draw the dog's attention). Just as the dog turns, the trainer clicks and calls the dog by saying "Come" (see *Introductory Lessons*). At this point, running backward, crouching, or clapping may help to increase the dog's willingness to come. If the dog comes, it is rewarded with a variable food reward delivered from a closed hand, affectionately praised, and released immediately with an enthusiastic "OK" and hand clap. On the occasion of some successful trials, the trainer can toss the dog a ball, play tug, prompt it to jump up, or engage it in playful roughhousing. In the case of dogs that enjoy ball play, the ball can be thrown to the dog at different points in the performance of the recall sequence (as soon as the dog steps toward the trainer, after taking five steps, and so forth). The ball can also be thrown immediately after the dog alerts to its name or as it is released from a halt-stay at a distance. If the dog fails to come, it is prompted to "Stay!" whereupon the long line is stamped on to stop the dog from advancing farther. During the walk, a ball or stick is occasionally thrown for the dog to retrieve. If the dog attempts to bolt away or refuses to return with the object, the long line is used to block the behavior and to condition a halt-stay response. Since coming is consistently followed by reward and release, dogs appear gradually to acquire an expectation that returning to the trainer not only helps to extend the time they get to walk freely, but is also associated with a significant amount of reward in the form of affection, food, and play.

Orienting is nine-tenths of the act of coming, and many dogs can be successfully trained

to come by means of reward-based incentives and intensive conditioning of the orienting response. A significant population of dogs cannot be trained to a reliable off-leash criterion of control by reward-based means alone. Many of these dogs can be rapidly trained to come when in the safety of a backyard or when walked on a long line; however, this control does not evenly transfer to situations where the dog is off leash and exposed to competing sources of reward. Training can be additionally transferred by slowly and painstakingly fading the long line, but such efforts are ultimately confounded and slowly degraded by competing environmental rewards whose occurrence or nonoccurrence are not yet under the trainer's control. Although the dog can be taken to the very threshold of a reliable recall via expert and conscientious reward-based training efforts by integrating many sources of environmental reward, the process is ultimately dashed on the wall of a stubborn reality: reward-based behavioral control is only as good as the trainer's ability to control environmental rewards. The success of long-line training is based largely on its ability to block behavior seeking the gratification of competing sources of reward.

Although competing control modules and routines established by the rewards presented or withheld by the trainer can help, many

FIG. 1.22. Throw-rings produce a distinctive sound that is useful for establishing off-leash control.

sources of environmental reward occur independently of the trainer's direction and remain a constant threat to control efforts. Since most extraneous environmental contingencies remain as they were before training was commenced, the dog's behavior relative to those contingencies remains largely intact—a fact that the trainer and dog quickly discover when the long line is finally removed. Essentially, the training process has provided the trainer with a valuable foundation of enhanced control with which to manage the dog in the context of uncontrolled sources of environmental reward. Such management is not equivalent to a recall and a halt-stay response. The recall and halt-stay responses must function reliably to control potentially dangerous or harmful behavior operating in the presence of extraneous sources of reward (e.g., bolting out of doors, charging after bicycles, cars, and passersby, or chasing other animals), not simply manage it (see *Electrical Stimulation and Chasing Behavior* in Chapter 9). Traditionally, the transition from management to recall and halt-stay control was achieved by fading the long line while at the same time introducing a variety of remote inhibitory control devices. Throw rings can be useful for this purpose: they are relatively safe and have a distinctive sound that is not easily confused with other common sounds (Figure 1.22). Unfortunately, the use of throw rings and similar tools for proofing off-leash recall is something of an art, perhaps a dying one, that requires significant skill and experience to pull off successfully. In addition to the necessity of good timing skills, the trainer must be able to throw such things with a high degree of accuracy. Few average dog owners possess the necessary skills for using throw tools properly. In any case, with the advent of sophisticated remote-activated electronic collars, proofing recall and halt-stay with throw tools is rapidly becoming an obsolete practice (see *Recall Enhancement* in Chapter 9). Electrical collars can significantly reduce many problems associated with off-leash control in a rapid and humane manner. To optimize the effectiveness of electronic training and reduce the possibility of adverse side effects, preliminary reward-based recall and halt-stay training should be thoroughly

carried out beforehand. Dogs that have undergone such preliminary training usually require very little electrical prompting to make the recall and halt-stay responses significantly more reliable. Finally, the goal of electronic training should be to produce an opportunity for additional reward-based training and safe exposure to the many quality-of-life-enhancing activities made possible by means of establishing off-leash control.

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2

House Training, Destructive Behavior, and Appetitive Problems

PART 1: HOUSE TRAINING

Adult elimination problems represent a significant source of distress for both owners and dogs. Not surprisingly, incomplete house training is the leading cause given by dog owners for relinquishing their dogs to the uncertain fate of the animal shelter (Salman et al., 2000), underscoring the importance of preventing and resolving house-training problems. Elimination problems are the result of a variety of causes, each requiring specific training programs to ensure effective control or management (see *Common Elimination Problems* in Volume 2, Chapter 9). The leading cause of household elimination problems, however, is improper or incomplete house training (Voith and Borchelt, 1985; Yeon et al., 1999). The majority of household elimination problems can be prevented with appropriate and effective house-training efforts begun at an early age. In general, adult

dogs exhibiting improper, incomplete, or unlearned house-training habits are treated in much the same way as puppies, until they are back on track.

HOUSE-TRAINING BASICS

The two primary goals of house training are to prevent the occurrence of elimination in the house while at the same time encouraging puppies to eliminate outdoors. Prevention depends on confinement or careful supervision while the puppy is moving about in the house. The importance of confinement and close supervision cannot be overemphasized. Keeping a record of house-training activities provides a useful source of objective feedback concerning a puppy's progress. Tracking daily house-training progress is especially useful in situations where a number of family members share house-training responsibilities (Figure 2.1). The chart allows others to see at a glance whether the puppy or dog has been taken out recently. The center column is used to indicate the number of accidents that occurred during the day, showing precisely how well things are going or not.

Confinement and Supervision

Effective house training depends on a combination of constructive confinement, diligent supervision, scheduled feeding, and the provision of adequate opportunities to eliminate outdoors. Several methods of confinement are used, including a loose leash, a crate or crate-holding pen combination, and tie-out stations. Crate confinement is particularly useful for initiating preventative restraint; however, as is discussed later in this chapter, excessive crate confinement may inadvertently produce significant adverse side effects. Over reliance on crate confinement may also interfere with effective house training by preventing a puppy from learning to generalize its training to the whole house. To optimize such generalization, a puppy should be exposed to all parts of the house while under influence of varying types and degrees of restraint, depending on its abilities. An easy way to accomplish this daily exposure is to walk the puppy around the house on leash or by tethering at various locations (tie-out stations) in the house. Tie-out stations consist of a length of braided nylon rope with a head loop and slide for easy fitting and removal. The puppy can be tethered in various ways, such as tying it to a piece of heavy furniture, knotting and slipping the rope under a closed door, or tying it to an eyehook screwed into molding. Initially, the length of tether should be approximately the sum of the puppy's height at the withers plus the distance from its nose to the base of its tail. Care should be taken to make sure that the puppy cannot become entangled in the tether or wrapped around something. Also, the tie-out station should not be close to valuable carpeting, furniture, or woodwork, since a puppy may chew while restrained. A blanket and toys that cannot roll away should be given to the puppy whenever it is tethered. As the puppy's reliability improves, the length of the tether can be gradually increased and finally eliminated via a fading procedure.

Although excessive crate confinement and isolation is not constructive, neither is letting a puppy run around the house unsupervised before it is ready for such freedom. In addition to inhibiting elimination, tethering offers several benefits that recommend its use. Unlike crate confinement, tethering provides more opportunities for the puppy to have close contact with family members while restrained. In addition to preventing inappropriate elimination, such restraint limits the amount of trouble the puppy can get into, thereby maximizing positive attention and socialization while helping to minimize punitive interaction. In the case of overly active or competitive puppies, tethering permits children to escape from mouthing and jumping excesses by simply scooting back out of the puppy's reach. Tethering also helps to constrain undesirable chewing activity by limiting it to appropriate chew toys left within the puppy's reach. Since tethering is frustrating for puppies, objects provided at such a time may acquire a preferential association as chew toys at times of increased frustration and emotional tension—an effect that may help to reduce destructive chewing later on when the dog is given more freedom to move about in the house.

Most accidents can be prevented if puppies are kept under careful observation and proper supervision. The owner should be instructed to watch for telltale signs both in body language and facial expression that have occurred in the past just prior to eliminating. Various signs can be used to predict and prevent future accidents (e.g., movement toward areas

HOUSE-TRAINING CHART									
	AM					PM			
	Location	Time	U	D	Total No. Accidents	Location	Time	U	D
M									
	FEEDING:					FEEDING:			
T									
	FEEDING:					FEEDING:			
W									
	FEEDING:					FEEDING:			
T									
	FEEDING:					FEEDING:			
F									
	FEEDING:					FEEDING:			
S									
	FEEDING:					FEEDING:			
S									
	FEEDING:					FEEDING:			
COMMENTS:									

FIG. 2.1. House-training chart.

that have been soiled in the past, sniffing and circling, whining when restrained by crate or tether).

There are various times when puppies are most likely to eliminate:

After awaking
After bouts of play
After any form of excitement
After eating or drinking and again 20 to 30 minutes later
After a significant period without eliminating

With diligent house training, most puppies can learn to eliminate outdoors with very few accidents. If a puppy is having several accidents every day, it is probably not the puppy's ability that needs to be improved, but the owner's supervisory efforts that need modification. When the occasional accident does occur, the owner should be prepared to respond appropriately and immediately to minimize adverse learning effects (see *Classical and Instrumental Learning* in Volume 2, Chapter 9). Elimination habits are under the influence of both instrumental and classical conditioning (Skinner, 1968), requiring careful attention to ensure that the behavior is brought under the control of appropriate environmental stimuli and reinforcement contingencies. Since the act of elimination is intrinsically negatively reinforcing for a puppy, allowing the puppy to eliminate in the house without a countervailing aversive consequence is tantamount to rewarding it.

Inhibitory stimulation should be sufficient to disrupt urination momentarily, but not so strong as to cause the puppy to become fearful or run away. For most puppies, an abrupt vocal shout combined with a clap or stomp on the floor is adequate to get the impression across. However, some puppies may require a stronger treatment involving the toss of some light object (e.g., a fluttering magazine) to instill a lasting impression. Whatever method is selected, it is critical that the puppy be caught in the act and then immediately rushed outdoors to finish it. Having the puppy on leash facilitates this movement outdoors. As the puppy is directed through the doorway, the owner's voice and manner should shift to a cajoling and encouraging tone, thereby causing the puppy to relax and finish the act outside. To improve the likelihood that the puppy will finish the elimination outdoors, it is imperative to catch the puppy at the earliest sequence in the act, ideally during preparatory or intentional movements. Although disrupter-type stimulation is appropriate and useful, excessive punishment should be avoided. Punishment causing a puppy significant discomfort or fear could cause it to overly generalize the event, thereby not only inhibiting elimination indoors, but possibly reducing the puppy's willingness to eliminate outdoors in the owner's presence, as well. A surprisingly large number of dog owners still believe that rubbing a puppy's nose in its mess is a helpful house-training deterrent. In a study involving people that had relinquished their dogs to an animal shelter, nearly 32% of those responding (N = 1947) believed that it was helpful to rub a dog's nose in its mess, with an additional 11.4% indicating that they did not know whether it was beneficial or not (New et al., 2000). Finally, retroactive punishment should be eschewed as an abusive misuse of punishment.

Placement Preference and Cleanup

Although the odor of previously deposited urine may act as an elimination cue, the importance of scent is often exaggerated, overshadowing other, perhaps more important, environmental cues affecting placement preferences. Actually, odor is one of many environmental cues informing placement preferences; others include habitual context and location, substrate, and remoteness from other basic biological functions (e.g., eating and sleeping). A poorly supervised puppy may urinate dozens of times throughout the house before the problem is finally recognized and brought under control, leaving many soiled areas undiscovered and uncleaned. Despite the presence of numerous indoor scent cues, once trained to eliminate outdoors puppies are rarely attracted back to these previously used and scented areas, suggesting that factors other than smell may be of greater importance in the development of placement preferences. Scent cues appear to play a much more significant role in the control of adult elimi-

nation patterns and urine marking. Some practitioners recommend the use of black lights, moisture-detecting probes, and biological dyes to find hidden urine spots, noting that, unless such spots are discovered, house-training efforts will be frustrated. In addition, high-tech, enzyme-activated chemical odor eaters are used to attack these attractants soaked into carpeting, ostensibly perpetuating marking behavior in adult dogs (see *Household Urine-marking Problems* in Volume 2, Chapter 9).

Cleanup after accidents should be thorough to reduce unpleasant odors and potential damage to carpeting and flooring. Rather than rubbing the urine deeper into the carpet, the key to proper cleanup is to first dilute and extract the urine. The first step is to get as much urine out of carpeting as possible. Paper balls, which make excellent disposable sponges for soaking up urine spots, are made by firmly wading together several sheets of newspaper into several softball-sized balls. In addition, these newspaper balls should be covered with a few sheets of paper toweling to protect carpeting from the ink on newspaper. As soon as an accident occurs, these paper sponges are used to extract urine by stepping and rocking on them. To dilute and further remove urine, a quarter cup of warm water is poured into the spot and then similarly sponged up. Finally, a solution of warm water and baking soda is poured onto the soiled area. The solution (one-quarter teaspoon of baking soda to one-quarter cup of warm water) is left to soak into the carpet for a minute or two and then thoroughly sponged out and allowed to dry overnight. When dry, the carpet can be gently brushed and vacuumed, leaving it clean and free of odor. The common practice of using vinegar should be avoided. Vinegar is particularly hazardous in the case of fine rugs. When exposed to sunlight, the acid in vinegar may produce a photochemical reaction with sunlight, causing sensitive carpet dyes to fade or discolor.

After the spot is cleaned and dry, a tie-out station can be set up nearby and the puppy restrained there for 15 to 20 minutes during the same time of day that the accident occurred. The puppy can be fed, massaged, trained, and played with over the spot. Also, the owner can seed the area with biscuits and allow the puppy to discover and eat them over the spot. A scent (e.g., an orange) associated with the puppy's crate can also be applied to the area. The goal of such training is to establish a number of associations with the area that are incompatible with the urge to eliminate, thereby replacing the expectations and preparatory sequences leading to elimination with those leading to the acquisition of food, toys, relaxation, and so forth.

House-training Schedule

A critical aspect of successful house training is the scheduling of meals and elimination opportunities so that they occur on a regular basis. Whenever possible, the puppy should be permitted to sleep in a bedroom. Initially, it may be necessary to confine the puppy to a crate placed next to the bed or tethered to a tie-out station. Before the puppy is confined for the night, it should be taken outside two or three times to give sufficient opportunity to evacuate fully. Giving the puppy a 10- or 15-minute walk before bedtime is a good habit for the owner to establish and maintain into adulthood. In any case, the owner should be prepared for the possibility of an early wake up, especially for the first week or two of house training. Whining in the middle of the night often signifies that a puppy is distressed by a need to eliminate. It is important for the owner to respond, but at the same time to push forward the puppy's biological clock steadily so that the puppy gradually learns to make it through the night. Instead of immediately responding, the owner should wait for a brief period before taking the puppy outside. During the first week or two, the puppy is progressively required to wait for longer periods until it can make it through the night. As the puppy's reliability improves, demonstrated by consistently making it through the night for at least 2 or 3 weeks, it can be gradually given more freedom to move about in the bedroom.

In the morning, the puppy should be taken to the same general location and vocally prompted to eliminate, using a voice signal previously paired with the act of eliminating. As the training process progresses, the puppy

should be encouraged to eliminate in different locations near and away from home, thus preventing the behavior from becoming overly contextualized to particular substrates and locations. When the puppy finally performs, it is rewarded with vocal encouragement and praise. Food rewards are usually not given to reward eliminatory behavior directly, but may be presented following defecation, especially if a puppy is coprophagous. Although elimination is intrinsically reinforcing, it is useful to provide additional social-positive reinforcement to counteract the generalized effects of punishment used to discourage elimination indoors. If a puppy fails to eliminate outdoors, it should be taken back inside and tethered or crated and taken out again after 15 to 20 minutes.

The length of time spent outside should be carefully controlled, with each outing not to exceed 1 to 3 minutes. Most puppies usually eliminate within the first minute after going outside. Instead of spending long periods of unproductive time walking and waiting for a puppy to eliminate, time outdoors is more efficiently used by giving the puppy several brief opportunities rather than one or two long ones. In the morning, most young puppies require three or four closely spaced opportunities outdoors to evacuate bowel and bladder fully:

Immediately after waking
Immediately after eating
20 to 30 minutes after eating
Again in association with outdoor play

During the day, multiple outings should be scheduled around feeding times. Between feeding times, puppies should be kept under close supervision or confinement, thereby preventing elimination from occurring inside the house. The average maximum length of time that a puppy should be expected to hold between daytime outings is calculated by dividing its age in weeks by 3. For example, an average 12-week-old puppy should be expected to hold for a maximum of 4 hours, with some puppies showing more or less control of elimination functions. Although some puppies are able to hold for longer periods, it may be stressful or unhealthful for them to do so. Initially, to minimize accidents, puppies should be taken out on a frequent basis (e.g., every 45 to 60 minutes) to establish the desired habit, gradually lengthening the period between outings to approximate the average age-appropriate limit. In addition to scheduled brief outings, two or more daily walks should be scheduled together with play sessions and positive training activities. Although requiring a puppy to hold for excessively long periods between outings should be avoided, giving the puppy too many opportunities to go outside may prevent it from acquiring appropriate eliminatory inhibitions. The crucial goal is to train the puppy to hold in response to internal elimination signals. Puppies that are taken out too often may not acquire this aspect of house training, but instead learn to respond to such internal cues as signals to eliminate or defecate. Not only must puppies learn to defer elimination to appropriate times and place, they must also learn to cope with the mild discomfort of holding a filled bladder or bowel.

Along these lines, teaching puppies to give a signal to go outside is a common, but questionable, house-training practice. While appearing reasonable and useful at first glance, encouraging puppies to give such signals may conflict with the objective of training them to hold and eliminate in accordance with an arbitrary schedule. Again, effective bowel and bladder control require that puppies learn to endure some amount of discomfort—an aspect of house training that is not necessarily served by training puppies to perform a signal to get outdoors on demand. Furthermore, such need-to-go signals depend on the owner being present to respond—a state of affairs that can rarely be maintained on a consistent basis. An unfortunate outcome of such training is the development of common elimination problems later. Unable to get the owner's attention with the elimination-need signal, a dog may go to the door and after a moment just turn around and eliminate nearby or run off to another room before eliminating, thereby reflecting the pattern previously established in association with the need-to-go signal, viz., give signal and then eliminate. Finally, many puppies rapidly learn to extend and generalize the need-to-go signal into a need-to-whatever-whenever sig-

nal, prompting the owner to go outside for purposes other than the dog's elimination. Such puppies learn that barking or pawing at bells can get them outside for play and other activities having nothing to do with elimination.

To prevent problems, the prospective dog owner should plan to take a two-week vacation to coincide with the puppy's arrival in the home to get the house-training process on track and perform other training activities. The owner should also plan to come home at lunch to feed and exercise the puppy for several additional weeks, if possible. Alternatively, a dog walker might be hired to take the puppy outside during the day. These and many other practical issues should be carefully considered before getting a puppy.

Common House-training Problems

The vast majority of puppies learn to eliminate outdoors on schedule with little difficulty. Most common house-training problems are the result of the following:

Fear
Distraction
Weather or surface aversions
Inappropriate interactive punishment
Improper house training

Fearful puppies that refuse to eliminate outdoors and prefer instead to eliminate after going back inside should receive appropriate behavior therapy consisting of graduated habituation and counterconditioning efforts. Puppies exhibiting specific fears should be exercised in locations away from fear-eliciting stimuli and only gradually exposed to such stimulation in association with counterconditioning. Fearful puppies should be provided with supplementary activities that promote feelings of safety and relaxation when outdoors (e.g., play and reward-based training). Overly active and inquisitive puppies may be excessively distracted by the novelty and excitement of being outdoors and fail to eliminate in a timely manner while on walks. Such puppies should be consistently taken to a familiar spot where exploratory interests have been habituated and only permitted to explore after eliminating (Borchelt, 1984). Puppies that refuse to eliminate as the result of weather changes or surface aversions should be provided with a surfaced area that is acceptable to them or taken to spots that are protected from the weather. Puppies should be gradually exposed to varying surfaces and weather changes to improve their willingness to eliminate. Rather than constraining its options, a puppy should be allowed to choose it spots, thereby facilitating more rapid habituation and willingness to eliminate in a timely manner. Walking the puppy to a remote part of the yard or requiring that it eliminate within a small area should be avoided, especially in puppies showing signs of inhibition about eliminating outdoors. Occasionally, as the result of inappropriate interactive punishment, the puppy may become anxious about eliminating in the presence of the owner, regardless of location, preferring to hide when back inside. In such cases, the punitive interaction should be discontinued and the puppy allowed to range away to a safe distance when taken outdoors. In addition to vocal encouragement, such puppies should be given food rewards or play after eliminating outdoors. Puppies that fail to eliminate outdoors should be taken back inside after 3 minutes and kept under close supervision on leash for 15 to 20 minutes (or longer depending on age and need) before being taken out again. This pattern is repeated until the puppy finally eliminates.

Dogs that habitually eliminate in the crate pose a significant problem (see *Elimination in the Owner's Absence* in Volume 2, Chapter 9). In cases were the behavior occurs overnight or at other times when the owner is present, increased opportunities to go outdoors may help to get the dog back on track and encourage better control. Sometimes simply making the crate smaller by inserting a divider can be helpful. However, in some cases, dogs may have simply lost their capacity to hold, perhaps as the result of repeated exposure to crate confinement exceeding their ability to hold. As a result, instead of holding in response to bladder signals, such dogs may simply learn to let go and urinate, often responding to progressively earlier signals in the sequence in advance of any significant discomfort associ-

ated with the holding effort. In other cases, the puppy may simply not exhibit sufficient inhibitory control over urinary sphincters to hold for long. Training such dogs to hold in the crate may require the use of a urine-activated alarm, giving the dog immediate feedback whenever it eliminates in the crate. The alarm consists of a moisture detector (available at most hardware stores) attached to quarter-inch cooper adhesive tape applied to a plastic crate tray (Figure 2.2). Two lines of tape are laid in parallel to each other so that a spiral form is made covering most of the tray surface. The tray is covered with a thick, open-weave blanket or a pegboard, allowing urine to run through and make contact with the copper tape. Now whenever the dog urinates a circuit is completed causing the moisture detector to activate an alarm that has been fastened to the inside of a plastic cup and appropriately muffled to match the auditory sensitivity of the dog. This arrangement is only suitable for use when the owner is at home or at bedtime, providing the owner with a signal while at the same time helping to inhibit urination in midstream. Such devices do not automatically reset and need to be manually switched off and urine wiped off the copper strips, making them unsuitable for dogs that are left alone in their crates.

FIG. 2.2. Moisture-detector alarm.

Another frequent source of house-training problems is preliminary paper training. Depending on the procedure used, paper training often violates both of the central imperatives of house training by allowing puppies to eliminate at will while indoors, albeit on papers or thereabouts. Owners often mistakenly choose the paper-training option to make the process easier for puppies and more convenient for themselves. A common adult elimination problem stemming from paper training is the tendency of some dogs thus trained to refuse to eliminate while on walks or when released outdoors, but instead waiting until they get back inside to eliminate—papers or no papers. Frustrated owners of such dogs are often at a loss to understand the origin of the behavior until the logic behind it is explored. Such dogs are performing in a manner consistent with the training that they received during an impressionable period of development for such learning. Although paper training is justified in the case of owners living in high-rise apartments or ones having disabilities or health problems, otherwise paper training should be discouraged. Of course, the temporary use of papers to protect flooring may be necessary if a puppy is left in a holding pen during the day. But even such stopgaps can result in problems such as the one just described, especially if such methods are used in an excessive and habitual manner. If the owner elects to paper train a puppy, the process should be performed in the same way as training the puppy to eliminate outdoors. Access to the papers should be restricted and allowed only in accordance with an appropriate house-training schedule. In most cases, efforts should be made to train the puppy to also use the outdoors, just in case such behavior becomes necessary in the future. Whenever possible, the first elimination in the morning should be performed outdoors to facilitate this dual training. Far from being easier, paper training, when properly performed, requires just as much, if not more, dedication

to achieve reliable control over the placement of elimination.

PART 2: DESTRUCTIVE BEHAVIOR IN PUPPIES

A common reason for seeking canine behavioral advice is destructive behavior. All puppies and dogs engage in varying amounts of exploratory and manipulative behaviors that may become misdirected into destructive activities (Figure 2.3). The problem is not chewing or digging per se, but rather chewing and digging activity that is inappropriately directed toward valuable personal belongings or things that may be dangerous to the dog. The goal of counseling and behavioral training in such cases is sixfold: (1) increase the owner's understanding of why dogs chew and dig, (2) identify evoking situations and contributory causes (e.g., separation distress, attention seeking, and insufficient exercise), (3) stress the importance of supervision and confinement, (4) discuss appropriate outlets for chewing and digging activities (e.g., chew toys and digging area), (5) discuss and demonstrate various techniques for discouraging destructive activities, and (6) provide basic training.

Puppies possess a need for a significant amount of daily chewing. Chewing provides stimulation and exploratory outlets, psychological benefits, metabolic (e.g., it elicits insulin secretion) and digestive effects, and a variety of homeostatic functions. Under the influence of adverse emotional arousal (e.g., barrier frustration) and inadequate exercise and social stimulation, chewing and digging activities may become exaggerated and problematic. As in the case of many other behavior problems, prevention is the key to the successful control of destructive behavior. Keeping puppies under a watchful eye and guiding their oral activities into appropriate outlets help them to develop habits incompatible with destructiveness. Strategic crate and pen confinement, tie-out stations, and leashing puppies help to reduce the likelihood that they will chew on forbidden items. Young dogs require a significant amount of social stimulation and opportunities to play, explore, and manipulate the environment with their mouths and feet. Playing various toy-oriented games (e.g., fetch, tug, and hide-and-seek) with puppies helps establish a durable preference for the toys used during such activities. Finally, puppies benefit from daily training activities consisting of following exercises, coming when called, sitting, lying down, and staying. All of these exercises can be introduced at an early age. Such training helps to improve puppies' attention and impulse control abilities, as well as enhancing their responsiveness to vocal control and direction.

FIG. 2.3. Puppies at play (John Hayes, 19th century).

ASSESSING AND CONTROLLING DESTRUCTIVE BEHAVIOR

Excessive oral activity may indicate a medical problem requiring veterinary attention. In cases involving abnormal destructive behavior and pica, a veterinary examination should be performed to exclude possible physiological causes. A general history and daily activity profile should be explored with the owner, including

Amount and type of exercise
Amount and type of play activities
Length and place of confinement

In addition, the trainer should obtain specific information about the objects chewed, the time of day when chewing is most likely to occur, and the various efforts already

attempted to control the problem (e.g., restraint, punishment, repellents, and so forth).

Selecting Appropriate Chew Items

Once an oral attraction is established, it may persist into adulthood and become very difficult to control or suppress. Consequently, it is important to encourage puppies to adopt an acceptable chewing pattern at an early age while they are most impressionable and receptive to such learning (see *Development of Exploratory Behavior* in Volume 1, Chapter 2). In addition to directing oral activities toward acceptable items, it is important consistently to discourage chewing directed toward forbidden household items. In addition to not being easily generalized and confused with forbidden items, a chew toy should meet three basic criteria: (1) it must maintain the puppy's interest, (2) it must sustain active hard chewing without being easily destroyed or eaten, and (3) it should not evoke guarding behavior. Although a nylon bone may satisfy criteria 2 and 3, it is not likely to be among a puppy's first choices in terms of attractiveness. A nylon toy can be made more appealing by drilling several small holes into it that are filled with cheese or peanut butter. Rawhide chew toys, while much more taste appealing, may not last very long, and many puppies may become overly possessive over them. Rawhide chew toys are better if they are slightly oversized and rolled, rather than knotted at the end. Despite the dire warnings in the trade literature to the contrary, rawhide chew toys are relatively safe for most puppies, but such toys may be inappropriate for dogs and puppies that chew through them too quickly. Rawhide toys are particularly appropriate after meals as aids in keeping the puppies teeth clean and facilitating digestion. After 20 to 30 minutes, the toys can be taken up and allowed to dry out between meals. Hollow rubber toys can be made more attractive by smearing peanut butter inside of them. Such toys can be safely left with a puppy when it is left alone, perhaps helping to ease mild separation distress by occupying the puppy. In addition to hard chew toys, most puppies, especially those prone to more severe separation distress, appear to be comforted by soft-cloth toys (Pettijohn et al., 1977), especially those scented with the owner's body odor. James (1961) studied toy preferences in puppies (2 to 3 months of age), finding that puppies exhibit definite preference toward soft or cloth-type toys:

> Those which elicited the most play were objects which could be bitten, carried in the mouth, held with the feet and pulled, and which could be held in the mouth and shaken. In general, soft objects were more attractive than hard objects. The piece of cloth with which two animals could play together definitely elicited the most play in the present study. (277)

Many puppies prize knotted ropes and fleece-type toys; however, such toys should be given only to puppies that do not destroy or eat them. For teething puppies, rope toys can be dampened and frozen.

Besides chew toys, puppies should also have access to a variety of interactive toys that can be used to play tug-and-fetch games. Training puppies to play tug games provides a constructive outlet for competitive play, with little risk of producing aggression problems (see *Play and Leadership* in Chapter 6). Consequently, tug games should be highly structured, with a beginning and end under the control of the owner. At the conclusion of a bout of tug, the puppy should release the toy (e.g., a ball with an attached loop of webbing), whereupon it is thrown a short distance away and the puppy encouraged to fetch it in exchange for another bout of tug or treat. Playing tug-and-fetch games helps to promote a positive association with toys and can be used to introduce new toys. Another useful game for introducing new chew toys is hide-and-seek. To stimulate interest, the puppy is briefly teased with a toy, which is then hidden out of sight but easy for the puppy to find. The puppy is told "Find it" and encouraged to find the toy. After repeated trials of such training, the puppy may learn to look for the item when motivated to play or chew. Another effective way to increase or maintain interest in chew toys is achieved by rotating them daily. This practice involves taking the toys up at night and giving them back at vari-

ous times during the day as a reward for good behavior or during bouts of play. Giving a puppy access to only a few toys at a time, occasionally taking them up and providing others, is another way to enhance their appeal. Whatever toys are chosen are of little value unless they are available to the puppy at all times. Remember that something is always within a puppy's reach when chew toys are not—clothing, molding, corners of furniture, rugs, plaster walls, and electric wires.

Many owners inadvertently facilitate undesirable chewing habits by giving puppies poorly chosen toys. For example, an old shoe may be offered to a puppy as ersatz toy in place of other shoes lying around the house. The owner soon discovers, however, that instead of satisfying a puppy's desire for shoes, giving it a worn-out one may only further increase its interest in shoes, worn-out or otherwise. Another common mistake is to forcefully remove forbidden objects from a puppy's mouth or attempting to capture a puppy by running after it to retrieve something that it has picked up. Instead of forcing things out of a puppy's mouth, it should be prompted to release objects by offering it a food treat in exchange. If a puppy has darted off with something, it is far better to call the puppy and reward it for relinquishing the object rather than trying to chase it down.

Whereas interactive games can help to instill an enhanced interest in toys, as well as reinforce cooperative behavior, chase games in which a puppy runs off with the toy in an effort to evade capture by the owner may promote a number of undesirable side effects, including an unwillingness to come when called and increased risk of producing undesirable possessive behavior.

Redirecting and Discouraging Destructive Behavior

To integrate a puppy successfully into a home, the puppy must learn not to disturb or destroy personal belongings. Although orienting a puppy toward acceptable chew toys is helpful, such efforts may not fully train the puppy to stay away from forbidden items. Eventually, such personal items as shoes, socks, undergarments, books, and plants will attract a puppy's interest. Keeping such things out of a puppy's reach is helpful, but eventually things are forgotten and left within the puppy's reach. Practically speaking, it is important, therefore, that puppies be trained to discriminate between forbidden household items and safe chew toys. Although direct techniques may ultimately be necessary to establish a sufficiently strong and durable object-related inhibition, indirect demonstrations may be useful as a starting point. Remarkably, an action modeled by a rival for the trainer's attention can have a powerful organizing effect on an observing dog's subsequent behavior, closely resembling what one might expect to occur if the dog had been directly stimulated instead of merely observing the model/rival (M/R) responding to the trainer's instructions and actions. Given the apparent benefits of the procedure for affecting object-oriented behavior, the M/R procedure should be explored in advance of going on to direct inhibitory training methods (see *Model/Rival Method*). While the M/R procedure may not establish a lasting deterrence or redirection of chewing activity, such preliminary demonstrations may help to reorient the puppy and, perhaps, make subsequent direct training efforts more efficient and rapid.

A surprising amount of control over destructive activity can be established by employing a novel stimulus (e.g., squeaker) to avert attention from forbidden items and reorient the activity to a more acceptable chew item. Clicker training can be used to enhance the puppy's orienting response to the squeaker (see *Orienting Response* in Chapter 1). Many puppies can be discouraged by saying "Leave it" firmly or by clapping and, if necessary, applying a leash prompt sufficient to turn the puppy away from the object and to redirect it toward a more acceptable item. Playing a tug-and-fetch game with the object can further enhance the puppy's interest in it (Table 2.1). The dog's sensitivity to directional cuing (pointing and glancing) can be used to help orient it to acceptable items, as well as improve its avoidance of forbidden ones. In the case of puppies that show a persistent interest in forbidden items, more emphatic disrupter-type stimulation may be

TABLE. 2.1. Managing puppy destructive behavior

Until puppies are reliable with regard to chewing activities, they should not be permitted to move freely about the house without supervision.
Puppies should be provided with supervised exposure to the home environment and surroundings sufficient to promote habituation, familiarity, and relaxation.
Attractive chew objects should be made available to puppies at all times.
Daily play, exercise, and social attention appear to reduce tensions associated with destructive behavior.
Disrupter-type stimulation and remote deterrents may be necessary to train puppies to stay away from forbidden objects. In addition to carefully timed corrections and booby trapping, repellents are often useful for controlling destructive appetites and excesses.
Puppies should be provided with daily reward-based training activities.

necessary in combination with behavior-activated and remote deterents. Forbidden items, especially those that have been previously damaged, can be used as temptations to help discourage future chewing by means of booby trapping and other deterrent techniques using startle and olfactory avoidance conditioning.

A highly effective deterrent is the sound made by a shaker can (see *Miscellaneous Items* in Chapter 1). A seven-penny can is usually sufficient. To charge the shaker sound, the can is tossed near a puppy that is engaging in a destructive activity with an object that has been scented with a novel odor (e.g., citronella-eucalyptus mix). The can should land close enough to evoke a startle response sufficient to stop the behavior, but not so close that it overstimulates or strikes the puppy. Alternatively, the forbidden scented item can be situated under a drop can, suspended by a length of dental floss held by the trainer and arranged to drop near the item but not risk striking the puppy. The suspended can arrangement allows the trainer to more closely define the level of stimulation produced (see *Three-step Deterrence: Step 3*). The can should contain cotton balls scented with the same odor scenting the forbidden item (e.g., electrical wires). The goals are to establish a conditioned association with the odor and to sensitize the puppy further to the odor by presenting it together with the startling sound of the can. As a result, the conditioned odor can be used on other items as an olfactory deterrent, as well as potentiating the startle effect of the shaker can, perhaps making the mere shake of the can an effective deterrent. Sniffing objects scented with a previously conditioned odor appears to cause puppies to react more keenly to the sound of the shaker as well as potentiating other sources of startle (e.g., vocal deterrents) used to control such behavior. In the case of sensitive puppies, a scented plastic vitamin bottle with holes drilled into it can be used as a shaker or a small scented beanbag can be used instead. Another way to establish a mild deterrent effect with sensitive puppies is by spraying a lightly scented stream of water toward the object at the moment the puppy approaches it.

Once a conditioned association between the olfactory stimulus and startle is established, booby traps should be set up to transfer control from situations in which the owner is present to situations in which the owner is absent or distracted. Booby traps are particularly important in the case of persistent, unhealthy, or dangerous chewing habits. A reliable method for doing this involves the use of a pull can. Tying a piece of dental floss to the ring of a shaker can and attaching it to the forbidden item rigs the pull can to fall when a puppy grabs at the object. The rigged can is placed on the edge of a shelf so that it will fall and land near the puppy but not strike it. Careful placement and testing of the arrangement can help to prevent such things from happening. A small amount of a conditioned odor is put on the forbidden item with a cotton swab. Objects can also be scented with a piece of paraffin wax that has been

melted and mixed with the conditioned odor. The pull can is strongly scented so that it delivers an impressive olfactory message, echoing the subtle odor on the forbidden object and reinforcing its significance as a warning signal. The net effect is to enhance the deterrence value of the subtle odor cue placed on the object and to provide a means to generalize the effect to other items without necessitating that an aversive startle be applied in each case. Another mild remote startle device is the upside-down mousetrap. This is especially useful for discouraging chewing on paper and similar light items (e.g., socks). The scented forbidden item as attached to the back of the trap with tape, and laid on the floor. If arranged properly, there is no risk that the puppy will be hurt by the trap as it snaps shut, but the odor and sound of the trap makes a clear and lasting impression. In some persistent cases, a shaker can or mousetrap is arranged in combination with a motion-sensitive alarm, so that the alarm is activated before the pull can or mousetrap is triggered, thus magnifying the effect of the event as well as providing reliable feedback if the puppy returns to the scented object (see *Controlling Inappropriate Chewing Activities).*

Most puppies quickly learn to stay away from forbidden things when some variation of the aforementioned methods is used. Of course, puppies that engage in excessive or dangerous chewing activities should also be carefully managed with crate confinement and tethering to prevent the unwanted behavior. Severe physical punishment (slapping and spanking) for destructive chewing should be eschewed because it will do little to control the chewing problem, but may generate undesirable fear and avoidance behavior. Although commonly practiced in error, belated punishment serves no useful function in the control of destructive chewing. Deterence that does not immediately precede or contiguously overlap the unwanted chewing should be avoided. Brief gentle scolding, although technically questionable, may produce a reminder effect in dogs that have previously received inhibitory training; that is, showing the item to the puppy or dog and saying "Not yours" or "Leave it" may not be without some benefit. Even if the procedure does nothing, nevertheless, it appears to help owners by giving them a way to let off steam in a controlled and inconsequential way. Alternatively, a model/rival procedure might be suggested as a better option for responding to after-the-fact situations, offering an approach that is more likely to produce a training effect without risk of adverse side effects (see *Model/Rival Method*).

Note: Puppies vary with regard to their sensitivity to startle. Consequently, startle-producing stimulation should be carefully adjusted to levels appropriate to a puppy's temperament and age. Particular caution should be exercised with young puppies, especially those between 8 to 10 weeks of age. Such puppies may be particularly sensitive to the effects of fear conditioning (see *Learning and Trainability* in Volume 1, Chapter 2).

PART 3: DESTRUCTIVE BEHAVIOR IN ADULT DOGS

A variety of adult behavior problems are associated with excessive chewing and other destructive behaviors (e.g., digging and scratching). Storm-phobic dogs may exhibit pronounced destructive behavior directed toward walls and flooring in an apparent effort to hide or escape stimuli associated with a storm. Many juvenile and adult dogs show destructive chewing and scratching only when left alone, often as the result of separation-related arousal and distress. Other dogs may chew and engage in other destructive activities as the result of inadequate impulse control associated with hyperactivity and excessive excitability. Chewing and scratching directed toward window casements and doors may occur secondary to territorial aggression or predatory excitement evoked by animals coming into the dog's view. Destructive behavior associated with fears, separation distress, hyperactivity, compulsions, and aggression needs to be addressed in the context of treatment activities aimed at reducing the underlying causes by applying appropriate behavior therapy procedures. Dogs exhibiting unusual destructive behavior or pica may be suffering from an undiagnosed medical condition

(e.g., hypothyroidism) requiring veterinary examination to detect and treat properly. The owner should be encouraged to keep a record of destructive behavior, including information on the time of day, location, presence or absence of the owner, object damaged, and possible causes (Figure 2.4).

A common source of destructive behavior in adult dogs stems from ineffective training and management of play and exploratory behavior. Highly active and inquisitive puppies rapidly learn that owner attention can be consistently obtained by bothering forbidden objects. Grabbing socks, undergarments, chil-

OWNER'S NAME:

DOG'S NAME:

RECORD OF DESTRUCTIVE BEHAVIOR
(LIST MOST RECENT FIRST)

#	LOCATION	TIME OF DAY	OWNER PRESENT / ABSENT	OBJEC
1				

DESCRIBE EVENT:

POSSIBLE CAUSES:

#	LOCATION	TIME OF DAY	OWNER PRESENT / ABSENT	OBJECT / DAMAGE
2				

DESCRIBE EVENT:

POSSIBLE CAUSES:

#	LOCATION	TIME OF DAY	OWNER PRESENT / ABSENT	OBJECT /
3				

DESCRIBE EVENT:

POSSIBLE CAUSES:

OTHERS:

4

5

6

FIG. 2.4. Record of destructive behavior.

dren's toys, and similar things serves to evoke a reliable and often entertaining activity. Some dogs appear to seek out and then daunt the owner deliberately with forbidden object, apparently with the goal of triggering a chase escapade through the house. Despite repeated scoldings, the behavior may continue unabated. If the owner ignores the dog, it may then chew the item. Dogs that have learned to grab and run off with forbidden objects may exhibit playful oppositional behaviors that require significant training and management to modify. In extreme cases, dogs appear to respond to the owner's disciplinary efforts as a provocative challenge to compete, causing them to become progressively resistant and difficult to control.

Such dogs often behave in precisely those ways that are most likely to yield the maximum amount of owner attention, often attention concentrated in a ritual of interactive punishment. Rather than discouraging the oppositional dog's game, however, the owner's ineffective punishment only seems to have an opposite effect. Driven by distorted attention-seeking incentives, oppositional dogs seem to thrive on negative attention as something desirable and rewarding. Oppositional dogs with destructive habits are often habituated to gradually escalating forms of punishment and, ultimately, may not be reached by the owner's most severe disciplinary efforts. In the context of punishing destructive behavior, low-intensity punitive events may be linked inadvertently with high-intensity reward outcomes (e.g., escaping owner control and running about with the forbidden object). As a result, the punishing event may become a signal entraining vicious-circle behavior (Brown et al., 1964), causing oppositional behavior and destructiveness to increase over time. As punitive efforts are applied again and again, a dog may learn to tolerate progressively more aversive events while at the same time acquiring a variety of escape and avoidance strategies to stay out of the owner's reach and to maximize the reward value of the activity. Instead of deterring the dog from engaging in future destructive behavior, the forbidden object becomes a discriminative stimulus setting the stage for a cat-and-mouse game. Playful opposition is often misunderstood as dominant behavior, but, more accurately, such dogs are most often simply incompetently and improperly trained.

Another common cause is excessive or inappropriate confinement or lack of daily stimulation. Dogs learn to become familiar with the environment by interacting with it. By sniffing, picking things up, scratching, digging, and running about, dogs gradually become comfortable with the environment via habituation. With familiarity and habituation come an increased sense of safety and a progressive ability to relax. Dogs that are excessively confined or restrained may not habituate to environmental stimulation normally, becoming highly active and inquisitive or reactive when allowed to move about freely to explore, sometimes resulting in significant damage [see *Environmental Adaptation (3 to 16 Weeks)* in Volume 1, Chapter 2]. Such dogs may get caught up in vicious cycle, such that excesses resulting from a failure to habituate cause the owner to confine and isolate the dog further, thereby making the problem worse. Dogs exhibiting excessive exploratory behavior in combination with destructiveness and pica need to be carefully supervised while gradually being given more room to move about, explore, become familiar, and habituate to the home environment. Borchelt (1984) has proposed that the space given to the puppy or dog to move about the home environment should be managed with a concern for basic behavioral and physiological priorities, adjusted in accordance with the dog's development and ability, while meeting the owner's needs to protect personal belongings, furniture, carpeting, and so forth from damage. Accordingly, space management serves three basic functions:

1. It provides for the biological and behavioral needs of a puppy.
2. It affords protection against damage to personal belongings, carpeting, and furniture.
3. It facilitates a puppy's behavioral adjustment to the human environment, appropriate to its stage of development and training.

In addition to generalizing house training to different parts of the house, space-management

strategies are used to systematically discourage destructive activities and introduce alternative chew items. The process of environmental adaptation is combined with integrated compliance training (ICT) and play. The cynopraxic concern for the establishment of interactive harmony converges with quality-of-life goals in the process of mediating the dog's adjustment to the home environment. The extent to which the dog is fully integrated into familial activities and free to move about the house is an important cynopraxic indicator of adaptive success.

BASIC TRAINING, EXERCISE, AND PLAY

Dogs exhibiting destructive habits in association with oppositional behavior usually benefit from basic training, which provides a structure of communication and rules that helps to resolve interactive conflicts and tension (see *Hyperactivity and Social Excesses* in Chapter 5). Many of the problems associated with this type of dog spontaneously improve as better attention and impulse control is established. As a dog learns to work for positive attention and rewards, a more stable and satisfying bond can be formed between the owner and dog, ultimately leading to greater cooperation and harmony. The goal of basic training is to provide oppositional dogs with a set of unambiguous social boundaries and expectations; above all, though, such training serves to systematically show them how to obtain what they want by means of cooperation. Opposition is drive energy not constructively channeled and put to work by training.

The development of refractory adjustment problems associated with destructive behavior often points to environmental deficiencies and problematic social dynamics. Whereas cooperative transactions serve to promote feelings of security (comfort and safety) and trust via reward, antagonistic and domineering transactions may produce significant conflict and a variety of emotionally stressful states or interactive tensions: anxiety, frustration, anger, fear, irritability, and so forth. A common source of persistent and harmful conflict and tension occurs in the context of ineffectual efforts to control undesirable or dangerous impulses. Dogs respond to punitive efforts differently depending on a variety of predisposing biological and experiential factors (e.g., prenatal and neonatal stress, early trauma, and deprivation), influences that may exert a lifelong effect by altering the dog's sensitivity and reactivity to aversive stimuli and conflict. Ineffectual, excessive, or abusive punitive efforts to control undesirable behavior may adversely influence emotional and behavioral systems most sensitive and vulnerable to reactive behavioral elaborations. An important aim of cynopraxic intervention is to systematically identify these points of interactive conflict and to mediate their resolution by means of counseling, appropriate training, behavior therapy, and environmental change.

Oppositional conflict develops in situations where the owner's control interests are contested by the dog's efforts to obtain reward. Particularly problematic interactive conflict of this kind develops in situations where behavioral limits are set by aversive means that are approximately equal to the motivational arousal driving the undesirable behavior, with the net result that the dog is equally averted and attracted to the situation. Over time, conflict and frustration may gradually escalate into defiance as the dog habituates to the owner's ineffectual punitive efforts, causing the owner to gradually increase the severity of the means used to constrain undesirable behavior, while the dog's desire for the forbidden reward object or activity continues unabatedly to grow. Such oppositional conflict and frustration may become ritualized, locking both the owner and the dog in a compulsive fixation from which neither is able to escape easily without outside help. Often the key to resolving such problems is to identify what the dog is trying to achieve and then providing it, or giving the dog something equivalent in value, on a contingent basis, thereby satisfying the dog's desire for reward and the owner's desire for control. The spell is broken as the owner learns to lead and show the dog how to gratify its needs, rather than just obstinately standing in the way.

Effective training for these dogs incorporates a balance of strategic confinement and integrated compliance training. Strategic con-

finement consists of crating, leashing, and tie-out stations located throughout the house. Keeping such dogs on leash in the house can be a highly effective means to prevent or discourage undesirable behavior. Basic exercises, such as sit, down, stay, coming when called, and walking on leash without pulling, should be trained to a high level of reliability and worked into daily activities until it becomes a way of life for owner and dog. Desirable activities and resources (e.g., attention, walks, food, play, toys, and affection) should be made available on a contingency basis, requiring that the dog perform some trained module or routine in exchange. While undergoing remedial training, the dog should be kept under constant supervision on leash or restrained in its crate or tethered to a tie-out station, gradually obtaining more freedom to move about unsupervised as warranted by improved household behavior. Simply training the dog to turn away from forbidden objects (squeak and click) and rewarding compliance by redirecting the appetitive activity into a more appropriate outlet can help to prevent problems, as well as provide a useful starting point for approaching already established habits.

In addition to daily obedience training, destructive dogs should receive daily periods of exercise and structured play activities. The dog's need for exercise varies according to the breed and temperament, with some individuals requiring much more daily exercise than others. A typical exercise program should include at least two 20- to 30-minute walks, once in the morning and again in the evening. For active dogs, an aerobic activity (e.g., ball play) should also be provided. Playful tug-and-fetch games with chew toys can help to focus a dog's interest on them.

Controlling Inappropriate Chewing Activities

The model/rival method can be incorporated in the context of helping. For a week, the dog should be carefully supervised and restrained to prevent access to inappropriate chew items. During this period, the dog should receive intensive attention and integrated compliance training. Emphasis is placed on training the dog to orient to the sound of a squeaker, a response that is rapidly bridged (click) and followed by a food reward delivered from the right with "Good." The dog should be trained to sit and stay reliably and to halt-stay and wait until it is prompted to come, to sit, or is released. The dog should also learn to walk on a leash without pulling, sit-stay, down and stay, make eye contact, and generally learn to cooperate. Chewing activity is restricted to a small assortment of attractive chew toys, provided during play and used as rewards for compliant behavior. The selected chew toys should be both attractive to the dog and resistant to sustained chewing. Appropriate toys should be given to the dog whenever it is tethered or otherwise confined. After this initial training and orientation toward appropriate chew toys, previously damaged items can be gradually reintroduced as temptations. For dogs prone to pick up and run off with forbidden items, the objects can be tied off to a piece of furniture with a piece of twine or attached to active-control line that allows the trainer to snatch it away from the dog. One object should be presented at a time in the context of redirecting the appetite to a new and acceptable chew object. The forbidden object is kept in full view of the dog as the trainer encourages the dog to tug and fetch the toy.

Model/Rival Method

A rival/model method of training may be useful in the context of modifying object-oriented behavior (see *Complex Social Behavior and Model/Rival Learning* in Chapter 10). The full value and significance of the M/R procedure for dog-training purposes remains to be determined; however, preliminary experiments by the author suggest that the technique may exert a potent and under appreciated organizing effect on a dog's behavior, especially with respect to modulating object-oriented behavior. For purposes of orienting the dog toward acceptable items and away from forbidden ones, the following M/R procedure may serve to enhance subsequent inhibitory training.

A trainer (T) and model/rival (M/R) sit on the floor with a puppy or dog that is tied

off on a tie-out or active-control line located a few feet away. The T and M/R stage instructive interactions around acceptable toys and forbidden objects. The T presents an acceptable toy to the M/R and says "Take it," which the M/R does, whereupon the T says "Good." The M/R puts a toy on the floor and picks it up again, and the T says "Good." Next, a scented forbidden item is held toward the M/R, saying "Leave it." In response to a vocal warning, the M/R should move slightly back, but then reach again for the object, at which point the M/R says "Leave it" in a more forceful tone of voice, causing the latter to flinch back once more. After a moment, the two objects are arranged on the floor at least 3 feet apart, and the dog is allowed to move toward them. If the dog goes to the acceptable item, it is rewarded with an excited "Good" and engaged in play. If the dog goes to the forbidden item instead, the T says "Leave it" and draws the dog back by the control line and picks up both objects. After a brief delay, the demonstration procedure is repeated, but now incorporating a seven-penny shaker can or modified carbon-dioxide pump. Again, the T offers the M/R the toy, saying "Take it" and "Good" as the M/R reaches and takes the toy. The same procedure as previously described is used when presenting the forbidden item, but now after the T says "Leave it," the can is shook once or a slight spritz of scented spray is delivered with a modified carbon-dioxide pump toward the object, and the M/R flinches back. Finally, both items are again placed on the floor and the is dog released. After choosing the toy, the T says "Good" and engages the dog in a brief period of play. If the dog goes to the forbidden item, the shaker is shook lightly or a brief spritz (not startling) from the pump is delivered, and the dog is pulled away from the object with the control line. Three trials of M/R training are performed per session.

Three-step Deterrence

In cases involving persistent appetites for forbidden objects and chewing in which other methods have failed or are inappropriate, the following method should help to ensure a lasting avoidance of forbidden items.

Step 1

With the dog on leash, the forbidden object is shown with the warning "Leave it," whereupon it is put on the floor. If the dog moves to take the forbidden item, a leash prompt is delivered with sufficient force to turn its head away from the item. In strongly motivated dogs, a fixed-action halter can be used to facilitate head control (see *Fixed-action Halter Collars* in Chapter 1). The entire procedure is repeated again until the dog shows an active avoidance toward the item. With every successful trial, the dog is praised, offered a treat, and encouraged to take an alternative item. The acceptable toy is presented to the dog, saying "Take it" in a playful tone. Prompting the dog to play tug-and-fetch with the object can be helpful at such times to enhance its interest in the item. Subsequently, the acceptable and ideally more attractive object is placed 1 or 2 feet from the forbidden object. The arrangement is intended to provide the dog with a choice between the acceptable item and the forbidden one. If the dog selects the acceptable item, the forbidden one is retrieved and removed. The dog should be petted while in possession of the acceptable chew item. This routine should be repeated in various locations throughout the house to generalize the effect.

Step 2

During step 2, leash control is gradually faded and a disrupter-type deterrent and conditioned odor are introduced to help further generalize the effect. With the leash dropped and dragging behind, the dog is taken to a room where a decoy and an acceptable chew toy had been previously left on the floor. If the dog goes for the forbidden item, the vocal signal "Leave it" is spoken in a clipped manner and a scented seven-penny shaker can is tossed next to the dog. If necessary, the leash is picked up and the dog is directed away from the object. The entire procedure is repeated, as needed, until the dog actively avoids the forbidden item and accepts the

alternative one. After a toss or two of the can, a single shake may be sufficient to produce the desired inhibition. In the case of dogs that are highly sensitive to auditory startle, the pennies can be put into a large plastic pill bottle. A scented cotton ball is put inside the bottle that has had several quarter-inch holes drilled into it.

Step 3

By the end of step 2, the dog should show an active avoidance toward the forbidden item while on leash and off, but the training process is not yet complete. A significant contextual cue controlling the avoidance so far established is the presence of the owner. Joseph Call and colleagues (Ainsworth, 2000; Call et al., 2003) at the Max Planck Institute in Munich have confirmed what applied dog behaviorists and trainers have long known about the influence of an owner's presence as a contextual cue, viz., dogs behave differently when they are under the scrutiny of a watchful eye. The researchers found that dogs can be readily trained to avoid food that has been placed on the floor, so long as the experimenter stays in the room and keeps an eye on them. Dogs tended to approach forbidden food in a more stealthy and roundabout way when they were closely watched, in contrast to the more direct approach used when the observer was absent, turned away from the dog, facing the dog with closed eyes, or distracted by some engrossing activity (e.g., playing a computer game). Dogs rapidly learn to control their behavior in accordance to contextual social cues, appearing to discriminate between contexts where the risk of interference is high (owner present) and where the risk of interference is low (owner absent or distracted). Consequently, the purpose of step 3 is to counteract this expectation of safety from interference when left alone by implementing various booby-trapping procedures. The most commonly used booby trap is the pull can, consisting of a scented seven- or 30-penny shaker can that is tied to the forbidden item by a length of dental floss and rigged to fall near the dog (Figure 2.5D). The can is placed on a shelf, top of a door, or other ledge in such a way that it lands close to the dog but without any risk of hitting it. Although the shaker should be strongly scented with a repellent odor, the item itself should only be lightly scented (e.g., stroked once or twice with a scented cotton swab). In some cases, additional stimulus dimension can be added and the startle effect magnified by placing a small paper cup on top of the pull can. The cup contains a small amount of water scented with a drop or two of the conditioned odor. In addition to protecting specific items, pull cans can also used to protect countertops and other areas, such as furniture. In this case, two or three cans are strung together along the length of the countertop with a single length of dental floss. Short lengths of dental floss can be attached to the line at various points that may then be fastened to temptations of various kinds (e.g., kitchen towels). When the dog jumps onto the counter or steals one of the booby-trapped items, the cans all come tumbling down with a convincing crash. The dog or puppy that grabs clothing hung over countertops can be strongly discouraged by hiding a shaker can inside of the item, so that when the item is disturb the shaker can tumbles down. Unrolling toilet paper is a common nuisance behavior that can be discouraged by placing a shaker can on the roll itself, often inhibiting the habit after a single startling crash of the can. Similarly, by taping the line of a pull can to the side of trash bins or directly fastening it to items inside the bin, a rapid and lasting inhibition about exploring such items can be established. In the case of persistent appetites for forbidden objects, regardless of the sort of pull-can arrangement used, the can should be rigged in combination with a motion- or movement-sensitive device that is activated in advance of the can falling down, so that the dog can avoid the startling stimulation by backing away in response to olfactory or acoustical warnings set up in close association with the protected object. The pull can is a one-time event, whereas the scent and motion-activated alarm is continuously available to deliver immediate feedback and warning to the dog.

Another important remote application of the shaker can is the drop can, which is different from the pull can in that it requires a trip line and trigger mechanism or must be directly

released by the trainer. A simple arrangement involving the drop can is used to discourage dogs from entering a forbidden area. The drop can is attached to a length of dental floss that is passed through an eyehook fastened to the wall or ceiling. An alternate method involves bending an opened paper clip to form an eye and taping it securing to the ceiling or doorjamb. Another eyehook is set up at the level of the dog's legs. The dental floss is passed through both the upper and lower eyehooks, stretched across the doorway, and hooked by a knotted loop to the trigger—usually a paper clip shaped to serve the purpose and taped to

FIG. 2.5. Various devices used to discourage destructive behavior: **(A)** motion, moisture, and vibration detectors, **(B)** remote electrical switch, **(C)** infrared alarms, **(D)** shaker can with materials to make a pull can, **(E)** modified compressed-air pump, and **(F)** various spring-loaded snapping devices.

the doorjamb or wall. The arrangement allows the suspended can to fall to the floor whenever the dog trips the scented dental floss. For exceptionally difficult dogs, an identical backup arrangement can be set up on the other side of the doorway. Applying a dilute repellent scent to the floor and doorjamb and using strongly scented drop cans helps to generalized the effect and provides a means to fade the trip-line and drop-can arrangement. Drop cans are occasionally used to discourage chewing on woodwork. Here, the line is passed through an eyehook, guided across the top of the door, passed through another eyehook and then pulled down and attached to a trigger device made by slipping the looped end of the dental floss under a splinter of damaged wood. If the dog returns to the area and attempts to chew, the can is released and crashes to the floor. Drop cans should be arranged and set up so that they do not fall directly on the dog.

Aversive Startle and the Control of Destructive Behavior

Effective aversive techniques should produce immediate and significant suppression, but not produce excessive fear or discomfort. Ideally, suppression should occur rapidly and after only a few exposures, often after a single event. Startling stimuli occurring in nature are often closely associated with potentially life-threatening events, with rapid escape and avoidance of such events serving to improve an animal's likelihood of survival. Organisms that required many exposures to a dangerous situation before learning to avoid it would be at a greater risk of injury or destruction than counterparts that rapidly learned to avoid danger as the result of one or a few exposures. Obviously, animals able to learn from a single exposure would posses a significant biological advantage over those not so prepared. Survival pressures appear to favor rapid escape and avoidance learning, especially with respect to exploratory behaviors that bring animals into contact with potentially harmful stimuli, requiring rapid appraisal and adjustments to escape or avoid them in the future. As a result, exploratory behavior appears to be highly sensitive to novelty and subtle changes that immediately precede startle-evoking stimulation. An important function of exploratory behavior is to detect potentially dangerous situations in advance of an injurious exposure. Since destructive behaviors often involve exploratory and appetitive incentives, they are highly responsive to aversive stimulation, with startle and behavioral disruption playing an important role in their modification and control.

Although aversive procedures often play a prominent role in the control of destructive behavior, such efforts should be used in combination with supportive reward-based training and efforts aimed at eliminating or reducing emotional and physiological causes contributing to destructive behavior. In addition, dogs need to be provided with adequate substitute outlets to satisfy their need for oral and somatic exploratory activities. Unless aversive control is combined with constructive positive training efforts, its deterrent effects are likely to be short-lived and may require many more repetitions to maintain. Another problematic aspect of aversive control is timing. Destructive behavior is often discovered long after the fact, tempting owners to apply punishment belatedly, but interactive punishment after the fact is unlikely to produce a beneficial effect and may only cause the dog to fear or mistrust the owner rather than helping to discourage the undesirable behavior (see *Separation Distress and Retroactive Punishment* in Volume 2, Chapter 4). Dogs appear, as Roberts (2002) has noted concerning animals in general, to be stuck in time and lack the ability to form episodic memories of long-past actions connected in a causal way to present consequences. Behavior-activated devices and booby traps provide the means to deliver startling consequences at the exact moment in which the unwanted behavior occurs, making such procedures highly efficient and efficacious.

Aversive procedures should only be used to achieve cynopraxic objectives not otherwise attainable by nonaversive means alone. Further, all training procedures that produce discomfort, startle, or loss should be applied in adherence to the LIMA principle and the dead-dog rule (see *Hydran-Protean Side Effects, the Dead-dog Rule, and the LIMA Principle* in Chapter 10).

MISCELLANEOUS DEVICES AND TECHNIQUES FOR DETERRING DESTRUCTIVE BEHAVIOR

Destructive habits and various nuisance behaviors occurring in an owner's absence often require special techniques and tools to resolve them. The transition from crate confinement to free or limited access to the house is facilitated by the use of behavior-activated devices strategically placed to discourage destructiveness, jumping on furniture and countertops, and keeping dogs out of certain areas without physical barriers. Such problems are often extremely frustrating since a dog may misbehave only when the owner is out of sight or out of the house. A common method for addressing this problem is to set up booby traps or to employ various behavior-activated electronic devices that have been designed to deliver a brief spray or electrical stimulus via a dog collar (see *Behavior-activated Electronic Training* in Chapter 9). Booby traps deliver an immediate disruptive event at the instant in which the unwanted behavior occurs, regardless of the owner's presence or absence.

Modified Mousetraps

Modified mousetraps can be used to discourage dogs from jumping on furniture, from damaging potted plants, or from entering forbidden outdoor areas. While some authorities recommend the use of mousetraps without modification (Hart and Hart, 1985), good results can be obtained with upside-down mousetraps and mousetraps that are modified by wrapping 6 to 8 inches of cotton gauze around the hammer and then taping it. Such an arrangement delivers a sufficiently startling impact without risk of injury or unnecessary discomfort to the dog. A few drops of a conditioned odor can be placed on the gauze, establishing an aversive conditioned association between the odor and the startle of the trap closing shut, thereby increasing the future value of the scent alone as an environmental warning and deterrence. The usefulness of the scent as a repellent is significantly improved by using this simple conditioning arrangement. For sensitive dogs or puppies, an upside-down mousetrap may produce a sufficient deterrence to keep them off furniture and away from forbidden areas. Scattering a few upside-down mousetraps on forbidden furniture can be a good deterrent for the sneaky lounger. Dogs with a penchant for exploring waste bins can be discouraged with a couple of upside-down traps placed under the trash. The interior of the waste bin can be scented with a repellent odor, so that the avoidance response is maintained even after the devices are removed. The upside-down mousetrap is especially useful to deter dogs keen on paper items. The forbidden item is lightly scented and fastened to the back of a mousetrap with a ring of tape and then laid on the floor or tabletop. An empty matchbook can be placed under the mousetrap to prevent the trigger from releasing the hammer too easily.

Caps and Snappers

Many devices using cap charges can be tailored to training purposes. The pull cap is a fireworks toy that is set off when two opposing strings are sharply pulled apart. The device is a loud and effective deterrent for dogs entering forbidden rooms or closets. One end is attached to the door and the other to the doorjamb. The cap should be placed up high near the top of the doorjamb to prevent flying debris from striking the dog. Perhaps the most versatile of this group of devices is the spring-loaded snapper. These devices are available in magic supply and novelty stores as exploding pens and coin rolls (Figure 2.5F). Once set, the least movement will set off the delicate mechanism exploding the plastic cap. Since the plastic cap flies off the cap snapper with some force, precautions should be taken to cover the device or insert it in a sandwich-size zip-lock bag. Also, the powder burn of the exploding cap can damage finished surfaces. It should be emphasized that cap devices should be used only as part of an overall plan of training and in most cases as a last resort. Caps and snappers are usually set up with scented objects or placed together with a motion-sensitive alarm that is rigged to go off before the cap.

Infrared, Moisture, and Motion Detectors

Various electronic gadgets can be highly effective high-tech alternatives to the previ-

ously described booby-trap devices (Landsberg, 1994). The most useful are those that are activated by infrared detection, motion and vibration, moisture, or radio signals triggering an electrical or spray event delivered by a dog collar. Infrared detectors contain a heat-sensitive sensor that passively responds to temperature changes caused by a dog walking nearby (Figure 2.5C). When the dog enters the field covered by the infrared detector, a high-frequency alarm is triggered and continues until the dog moves out of the field, whereupon it stops and resets. Such devices can be very useful for protecting both objects and areas, such as countertops and furniture. Other devices are designed to detect photoelectric disturbances caused by a dog's movement. The photoelectric detector works by producing a beam of light that is reflected back to a light sensor. When the beam of reflected light is broken, a chime sound or loud external alarm is triggered. These devices are commonly used in stores to monitor the entrance and egress of customers. An advantage of photoelectrical detectors is that they can be used to define a highly specific area or boundary. Both passive infrared and active photoelectric detectors can be used to deter a wide variety of destructive activities. Motion- and vibration-sensitive detectors are also available with a built-in alarm and a panic-button switch (Figure 2.5A). These devices are hung on doorknobs to detect intrusion. When the door is banged or opened, the alarm is triggered, continues for 20 seconds or so, and then resets. Motion detectors can be placed on furniture or attached to forbidden items by a length of dental floss in order to deter unwanted activities. Such devices are small enough to put inside a shoe, wrap in clothing, place in trash bins, and so forth. Because such devices produce a continuous loud noise for 20 seconds, they should be used only in situations where the dog is able to move into another room away from the alarm. Moisture detectors with built-in alarms can be modified in various ways to protect areas being licked or chewed by a dog. For example, wire leads with alligator clips can be attached to the moisture-sensitive probes and fastened to two strips of quarter-inch copper tape. The pieces of copper tape are applied to the chewed area leaving an eighth-inch gap between them. When the strips of mounted tape are shorted by lick and saliva, an alarm is triggered and continues until the dog backs away. Another simple moisture-activated device can be set up by hooking quarter-inch copper adhesive strips to a 9-volt battery. Again, an eighth-inch gap should separate the copper strips so that a short is formed between the positive and negative poles of the battery whenever the strip is contacted by the tongue and lips; the arrangement delivers a mild shock. In any case, a conditioned odor should be applied to areas and objects protected by electronic sensors and deterrents in order to help generalize the effect.

Compressed Air

The carbon-dioxide (CO_2) pump (available at bike shops or computer stores) is modified to make it a useful training tool. The modification consists of a small cotton wad that is inserted into the base of an inflation needle that is firmly screwed into the nozzle of the air pump. After screwing the inflator needle into the pump, the needle part is wiggled back and forth until it breaks off (Figure 2.5E). This simple modification serves two functions: it prevents an excessively forceful discharge of CO_2 air, and it permits the user to dispense an odor by means of highly controlled air pressure and directional flow, making it easier to direct scented or unscented air toward some nearby or distant location. The lever valve on the CO_2 pump allows the user to release a controlled amount of scented or unscented pressurized air, producing an inaudible mist, a faint spray, puff, hiss, spritz, or startling burst, depending on training needs. The CO_2 pump can be used in a variety of ways to interrupt behavior or to produce positive or negative conditioned effects. When used to limit destructive behavior, a scented spray is directed toward the forbidden item, thereby generating a significant startle while at the same blowing the object out of the dog's reach and scenting it with the conditioned odor. After two or three applications, the

odor itself acquires a significant inhibitory effect and can be directly applied to forbidden objects (Otto and Giardino, 2001). In addition, olfactory startle conditioning may potentiate a dog's response to other sources of startle (e.g., the pull can), making them significantly more effective when presented in conjunction with a previously startle-conditioned odor (Paschall and Davis, 2002) (Figure 2.6). Also, once dogs are sensitized to the sound of an air pump, simply making a hissing sound can produce a mild inhibitory effect. Although the aforementioned nozzle modification helps to improve the safety of the air pump, several safety precautions should be observed when using the

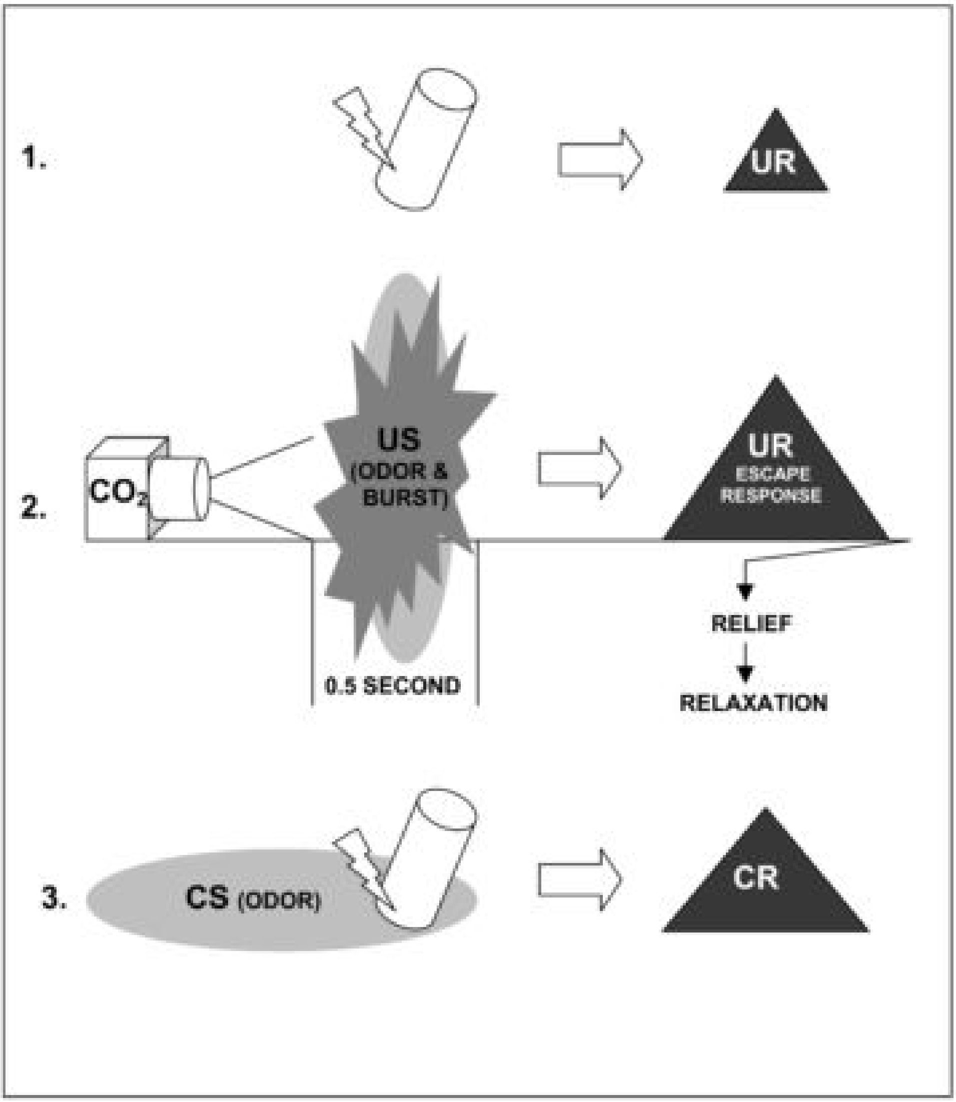

FIG. 2.6. Olfactory-mediated startle potentiation can play a valuable role in the control of destructive appetites and excesses. A previously conditioned odor applied to a forbidden item provides an avoidance cue as well as potentiating the effect of other startle events occurring in the presence of the odor. US, unconditioned stimulus; UR, unconditioned response; CS, conditioned stimulus; and CR, conditioned response.

device. The pump should never be pointed at the dog or sprayed toward the dog's face, near its ears and eyes, into its mouth, or directly against its skin. The discharge of compressed CO_2 may precipitate dry ice and cause burns if it is applied directly to the skin. Using the modified CO_2 pump safely and effectively requires some skill, and it should be kept out of the reach of children and family members not instructed on its proper use.

Repellents

Olfactory and gustatory repellents are commonly used to deter dogs from chewing and other destructive behaviors. In contrast to devices used to repel and deter dogs from engaging in destructive behaviors by stimulating auditory startle, chemical repellents serve a similar function by eliciting irritating sensations or disgust/nausea, as in the case of taste aversion (see *Taste Aversion* in Volume 1, Chapter 6). As previously discussed, conditioned odors produce a repellent event as the result of aversive conditioning in which the odor is paired with the occurrence of a startling event. A major drawback of repellents is that dogs may quickly learn to circumvent the strategy by avoiding treated objects but continue to chew objects that have not been treated with the repellent. Similarly, objects that have been scented with a conditioned odor may be avoided, but others not treated may inadvertently attract continued destructive interest. In the latter case, the absence of scent may actually help dogs to predict a degree of safety from aversive consequence. Repellents producing an acid, sour, or bitter taste do not appear to be very effective deterrents for the control of predatory behavior in wild canids (Mason et al., 2001) or scavenging garbage in dogs (Wolski et al., 1984).

Despite the aforementioned limitations, most dogs appear to respond to the deterrence produced by conditioned odors and repellents; however, when such substances are used in isolation from positive training activities, they probably do little good. Available commercial products offer varying degrees of effectiveness. With respect to repellents, odor-based substances do not appear to be very useful unless they are conditioned to evoke avoidance. The best repellents are those that directly irritate mucous membranes (Houpt et al., 1984), such as pepper derivatives (e.g., capsaicin). The most commonly used repellent substance is cayenne pepper in the form of hot sauce. Cayenne pepper can be also be applied as an alcohol extract/solution or paste. A mixture of cayenne pepper and alcohol consists of 1 tablespoon of cayenne pepper mixed into a quarter cup of alcohol. The mixture is thoroughly stirred and then let to sit for an hour or so, until the pepper granules sink to the bottom. The reddish alcohol solution that separates from the pepper is decanted and applied sparingly with a paintbrush or cotton swab to forbidden objects and areas. After application, the alcohol rapidly evaporates, leaving pepper resins behind on the treated surface. A paste of red pepper is made with water and small amounts of hair gel. The paste is typically slathered on wood objects (e.g., furniture and woodwork) that have been chewed in the past. Cayenne-pepper solution can stain or damage woodwork and fabrics, making the solution and paste inappropriate for some surfaces. Alum, an astringent, offers a mild alternative to cayenne pepper. Black pepper can be applied under the fringes of carpets or to other areas being chewed or scratched.

Digging

Most dogs spend large amounts of their waking time engaged in exploratory activities of various kinds, behavior that is essential for healthy development and normal environmental habituation. As the result of poor management or training, these natural exploratory interests may become exaggerated or misdirected into destructive activities, causing significant concern for dog owners. Some breeds (e.g., terriers) are more prone than others to dig. Likewise, highly active dogs (sanguine types) are more frequently

presented with digging problems than more relaxed and reserved dogs (phlegmatic types). In addition to predatory incentives stimulated by insects, worms, and other creatures living in the grass and soil, some digging dogs appear to enjoy the tug stimulation of pulling out shrubbery roots. Although some dogs may bury and recover buried food items (e.g., bones), this is not as common as one might suppose from the popular literature. Interestingly, wolves dig holes to cache food and urinate over areas where food has been dug up and removed (Harrington, 1981)—a behavior pattern not reported in dogs. Most common outdoor destructive complaints revolve around chewing and digging, operating under the influence of normal canine functional and motivational systems (Odendaal, 1996). Consequently, the causes of digging are numerous and varied, requiring careful history taking and observation. The owner should be asked the pertinent questions involved in any behavioral assessment, viz., the three W's (what, when, where) and the three H's (how long, how frequent, and how severe) (see *Behavioral Fact-finding* in Volume 2, Chapter 2). Some digging activity is simply part of having a dog, requiring in some cases that owners adjust their expectations rather than attempting to suppress all digging activity. Puppies, in particular, appear to enjoy the fresh smells and tastes of tender roots and freshly turned earth. In addition to the inherent pleasures associated with digging, a dog might use the activity as a somatic outlet for the release of various tensions involving boredom, frustration, and stress. As a result, excessive digging may become a compulsive outlet for dogs living under suboptimal conditions.

The location of digging activity can offer clues about its underlying causation. Digging along fence lines and near gates may stem from efforts to escape confinement due to territorial aggressive arousal, barrier frustration, fear, or separation-related distress. Digging near resting areas, under trees and shrubs, especially during the summer, may be motivated by an urge to expose damp earth just beneath the surface to roll in and cool down. To arrive at a successful solution, it is important that the motivational causes be identified and, if possible, removed or reduced before attempting to suppress undesirable digging. For example, bored dogs should be given additional exercise and play activities that provide adequate opportunities for stimulation, separation-reactive dogs need to learn how to cope more effectively with being left alone, and dogs digging to achieve improved thermoregulation should be provided adequate water to drink and a small plastic wading pool. Such dogs should also be provided with outdoor accommodations that provide better protection from heat when outdoors. When barrier frustration is identified as a factor, potential causes of frustration should be explored, for example, a high sex drive and desire to roam, the presence of roaming neighborhood dogs, or any other occurrences stimulating intense arousal and interest. Most digging problems appear to benefit from increased daily attention, obedience training, and exercise. Even after the aforementioned motivations and causes have been addressed, a dog may still engage in unwanted digging behavior. For many dogs, digging is inherently rewarding, providing a welcome distraction when left alone or understimulated. Because many dogs appear to possess a predisposition to dig, owners of persistent diggers should be advised to provide an area in the backyard set aside for digging activity. The digging area can be temporarily fenced off and baited with buried toys and biscuits. While digging is permitted in the designated area, excavations in other parts of the yard should be consistently discouraged. Some persistent diggers may not restrict their excavations to such areas, however, requiring the implementation of various behavior-modification efforts.

Dogs exhibiting an inordinate interest in digging should be consistently interrupted whenever they are observed engaged in the activity, and then encouraged to take up another activity such as ball play. Keeping the dog on a leash or long line can help facilitate this process. Some digging excesses can

be discouraged with a vocal reprimand ("Leave it") and appropriate leash prompt sufficient to interrupt the activity. A modified CO_2 pump with conditioned odor can be highly effective as a disrupter. Tossing a 30-penny shaker can near dogs while they are digging will rapidly interrupt and potentially stop its recurrence, at least so long as the owner is present. In addition to pennies, the can should contain a cotton ball scented with citronella-eucalyptus oil or commercial repellent. The conditioned odor (e.g., citronella-eucalyptus paraffin shavings) can be placed into holes, along with a startle-producing booby-trap device. For example, a motion-sensitive alarm can be sealed in a ziplock bag and placed into holes and covered with loose dirt and grass. A repellent effect might be achieved by mixing a tablespoon of cayenne pepper into a cup of sand, which is placed into a scented plastic bag that is tightly knotted and placed into a covered hole. Another method involves placing a remote-citronella collar in the hole or forbidden area and activating it when the dog digs or approaches the area too closely. In refractory cases, electronic training can be highly effective for suppressing digging activity (see *Electronic Training and Problem Solving* in Chapter 9). A stronger booby-trap arrangement is reserved for inveterate diggers. Several spring-loaded snappers are sealed in sliplock bags and buried at various levels together with citronella-eucalyptus wax shavings. As a result of such training, the conditioned odor may be used to help deter future digging activity by putting it other active holes.

Dogs that dig under fences can be deterred by attaching vinyl-coated wire fencing to the base of the fence and then burying it 6 to 10 inches underground. In cases where a physical modification of the fence is not practical, an electrified wire can be strung along the base of the fence to provide protection against escape efforts. Electric-fence controllers have been designed for dogs, producing a moderately strong electric shock when touched. When installing such devices, care should be taken not to allow it to come into contact with grass or other grounded objects. Another method involves stringing an electronic containment wire along the base of the fence. Either an electrical or spray boundary collar device worn by the dog should be sufficient to deter most escapists from digging or climbing over fences. Destruction of gardens and planted areas can be most effectively managed by setting up fencing that keeps dogs out of those forbidden areas.

PART 4: APPETITIVE PROBLEMS

Pica and Scavenging

Scavenging forbidden food and eating nonnutritive objects (pica) are common ingestive behavior complaints, requiring both behavioral and medical assessment (see *Pica and Destructive Chewing* in Volume 2, Chapter 9). Pica may present comorbidly with compulsive or hyperkinetic disorders, perhaps requiring adjunctive pharmacological intervention to manage successfully. White (1990), for example, found that one dog in his study of acral lick dermatitis (ALD) was also a rock chewer—a behavior that ceased together with the dog's ALD following treatment with naltrexone. In some dogs with pica, the appetitive-seeking system may be overly active, resulting in hyperarousal and excessive exploratory activity, chewing, and eating of nonnutritive items—signs consistent with hyperkinesis. Dogs showing a persistent appetite for nonnutritive items need to be carefully managed and supervised to prevent alimentary blockages or poisoning. A scavenging dog should be closely controlled on walks, perhaps keeping it on a fixed-action halter collar to turn its head more easily away from found food and garbage. At such times, the vocal signal "Leave it" is combined with a leash prompt strong enough to turn the dog's head away from the object. In addition to interrupting the scavenging response directly, the owner should encourage the dog to turn its attention away from the prized item by using various vocal signals

and auditory prompts (e.g., squeaker or smooch sound) and reinforcing the orienting response with a click and flick of the right hand to present a food reward. Such refocusing of attention away from the forbidden object toward the owner is consistently rewarded with treats of varying kinds and value taken along on walks. The dog also needs to be trained to release or drop anything it grabs. This phase of training is initially introduced with toys, with the dog being encouraged to take and release toys of increasing value in exchange for a proffered treat. This release-and-trade routine should be rehearsed and staged indoors and under controlled conditions before transferring it outdoors. As the dog learns to release the target item in exchange for food, the vocal signal "Out" is paired with the action as a discriminative stimulus. In addition to learning how to release toys, the dog should be trained to take them from the floor or hand on signal ("Take it").

Once the releasing and taking behaviors are under stimulus control, more compulsory safeguards are introduced to ensure that the dog avoids or rapidly releases forbidden items found on walks. The itinerary of the walk can be planted with forbidden items in advance, with their locations marked for easy recognition. An alternative method involves dropping forbidden items at various places on the outward leg of a walk and then training the dog to avoid them on the way home. Avoidance of forbidden objects is conditioned by combining directive leash prompts sufficient to turn the dog's head away together with various startle devices (e.g., the shaker can or modified CO_2 pump). As the dog approaches a forbidden object, the trainer shouts "Leave it", whereupon, if the dog fails to turn away on its own accord, a leash prompt is delivered that is strong enough to turn the dog away abruptly from the object. This procedure is repeated until the dog is reliably avoiding forbidden objects in response to the voice command "Leave it." Compliance to the limit-setting imperative is rewarded with affectionate praise and food as the dog returns to the trainer. Dogs with strong oral exploratory interests should also be provided with frequent opportunities to chase and retrieve toys taken along on walks for such purposes. To help generalize the avoidance response to off-leash situations, a shaker can or other startle-generating objects (e.g., throw rings) can be tossed near the forbidden object with the reprimand "Leave it!" Later, as the result of sensitization, a single shake of the can may be sufficient to deter future interest in the forbidden item. Transitioning from on-leash to off-leash control often requires that forbidden items be arranged to trigger some sort of booby trap, including drop cans and various remote-activated and behavior-activated electronic devices (see *Miscellaneous Devices and Techniques for Deterring Destructive Behavior)*. For example, a remote spray receiver can be concealed close to a forbidden object and activated by the trainer as the dog approaches it. In refractory cases of scavenging and pica, remote electronic collars delivering a spray or electrical deterrent can dramatically facilitate inhibitory training and aversive counterconditioning. Remote electronic collars can be highly effective, but they require significant owner instruction and preliminary training before use (see *Punishment and Aversive Counterconditioning* in Chapter 9).

Getting objects out of a dog's mouth once they have a hold can be difficult and sometimes dangerous. Many dog owners have been severely bitten in the process of prying a chicken bone out of their dog's mouth. Despite the risk presented by some dogs, the majority of dogs appear to allow owners to reach into their mouths to pull forbidden items out. Others may resist until the owner places a hand over the muzzle and gently squeezes the upper lip against the premolar teeth. Although commonly used, both of these maneuvers are risky, and it is far safer to train the dog to drop forbidden items on command and to back away (see *Aggression Associated with Guarding and Possessiveness* in Chapter 7). Dogs that persistently refuse to release dangerous objects (e.g., chicken bones) should be kept on a halter collar while on walks, as needed to prevent such behavior.

Coprophagy

Coprophagy is a common complaint presented by puppy and dog owners. A study using an owner questionnaire and involving 305 dogs living in Czech households found that 36% of the dogs ate feces—a habit that was more common among females (45%) than males (30%) (Baranyiová et al., 1999). Most owners are disgusted by the habit and are quick to punish such behavior. Although most dogs can be discouraged with routine prevention and training efforts, some dogs may persist in the behavior despite consistent training efforts or comply only so long as the owner is present. A wide variety of techniques have been devised to manage or suppress coprophagy. No one method is effective in all cases, but most dogs eventually respond to a combination of management and training efforts. Since coprophagia is sometimes associated with disease, the dog should be given a veterinary examination to exclude a medical cause. Persistent coprophagy is a serious problem, not just because it is potentially a health risk for the dog, but because it may threaten the human-dog bond as a result of owner displeasure and disgust with the habit. Consequently, coprophagy should be treated with sensitivity and not summarily dismissed as a normal thing that dogs do and something the owner should get over and learn to live with.

Hot Sauce, MSG, Breath Mints, and Other Concoctions

Aside from interactive punishment, the most common method used to discourage interest a dog's in feces is to contaminate the feces with hot sauce (O'Farrell, 1986). Unfortunately, the approach is rarely effective because the dog simply moves on to a fresh deposit that has not been contaminated. Recognizing the obvious shortcomings of coating feces with hot sauce, Houpt (1991) has suggested that the hot sauce be injected into the feces with a syringe and hypodermic needle. The operative assumption is that by injecting feces the dog will be unable to detect the hot sauce until it is too late, causing it to avoid untreated feces as well because it can never be sure which pile contains the repellent. However, given the extraordinary acuity of a dog's nose, it is unlikely that most dogs would be fooled by such a trick. Furthermore, even if the odor could be effectively masked inside feces, the exercise would probably still be in vain since dogs usually swallow the feces in a single gulping action, not leaving much time for the repellent to disperse into the dog's mouth before it is swallowed. Finally, many dogs will bolt down feces sloshed with hot sauce, showing little sign of aversion to the fecal condiment.

Other common remedies are given to dogs to eat in order to make feces less attractive, including meat tenderizers, monosodium glutamate (MSG)-based products, sulfur, and breath meats. There is little evidence that such methods actually work, but positive anecdotal claims have been made for meat tenderizers containing papain and products containing MSG (Carlson and Giffin, 1980). Although the usefulness of MSG for the control of coprophagy has not been demonstrated, it is frequently recommended as a way to make feces less attractive to dogs. Grinding breath mints into a dog's food has also been suggested for the control of coprophagy (Taylor and Luescher, 1996), but no data or rationale are offered to explain the treatment. Other foodstuffs that have been suggested include canned pumpkin, pineapple juice, and anise extract. Both canned pumpkin and pineapple juice are a source of papain. Sulfur-containing foods (e.g., brussels sprouts or cabbage) might be tried, based on a report suggesting that small amounts of sulfur may make the feces less attractive to a dog (Hubbard, 1989). Another alternative source of supplementation is sulfur-containing amino acids (e.g., cystine and methionine) or foods containing high levels of the same. Ferrous sulfate (iron) has also been recommended as way to adulterate feces and make it less palatable (Mugford, 1995). The addition of cooked liver (a good source of iron) to a coprophagous dog's diet might provide some benefit. Adding fiber (e.g., cellulose-containing vegetables like cooked carrots, green beans, and broccoli) to the diet may alter the texture

and smell of the feces sufficiently through natural fermentation to make it less attractive to dogs. Finally, *The Merck Veterinary Manual* (Fraser et al., 1991) recommends feeding a high-protein/low-carbohydrate diet supplemented with vegetable oil twice daily, claiming that such a diet can control the problem (in many cases) within 2 months. Adding chemicals and supplements to a dog's diet can be potentially harmful and should be done only under the supervision of a veterinarian.

Nutritional and Dietary Changes

Because a dog might be attracted to partially undigested food remaining in feces, adjusting the diet in terms of its schedule, amount, and nutrient quality may be helpful. Consideration should also be given to adjusting the proportion of protein to carbohydrates and fat in the dog's diet. When possible, coprophagous dogs should be fed high-quality food provided on a multiple-opportunity feeding schedule (two or three times a day, depending on the age and needs of the dog). In addition, the diet might be supplemented with muscle or organ meat (liver or heart) on a temporary basis. Since a coprophagous dog may be seeking B vitamins in the feces, a vitamin supplement, rice bran, or brewer's yeast should be considered (Cloche, 1991). Lastly, a fish-oil supplement might also be considered and added to the dog's diet in appropriate amounts. Many practitioners recommend adding a meat tenderizer containing papain to the dog's diet. Papain can also be obtained in a pure form from most health-food stores. Dogs that prove responsive to commercial meat tenderizers should be given a trial period on papain, either from a natural fruit source (e.g., canned pumpkin) or from an extract powder mixed into their food. Alternatively, products containing a broad spectrum of digestive enzymes (e.g., Prozyme) seem to be effective in many cases.

Preliminary Training

The dog should be prevented from having access to feces for at least 2 weeks, during which time dietary changes and supplementation can be introduced, if warranted, together with supplemental play, exercise, and reward-based obedience training. Ideally, a coprophagous dog should be walked on leash and distracted from feces by calling its name and smooching or squeaking to interrupt interest in the feces and divert its attention toward the owner. As the dog turns away from the feces, it is called ("Come") and rewarded with appropriate encouragement and rewards. The yard should be kept clean of feces. After eliminating, the dog should be praised and a small biscuit tossed out in front of it to pick up. Small biscuits can be covertly dropped during the walk for the dog find on the way back. Likewise, the yard can be seeded with biscuits for the dog to find when let out to play. If the dog ignores efforts to get its attention and approaches the feces, the reprimand "Leave it" is spoken in a firm tone, followed by a directive leash prompt sufficient to turn it away from the feces and toward the owner. The procedure is repeated until the dog turns away from the feces or avoids it in response to the voice signal alone. Additional training may require the use of disrupter-type stimuli, such as the toss of a 30-penny shaker can or burst of air from a modified CO_2 pump. Again, exposure is repeated until the dog shows an active avoidance of feces while on walks.

Booby Traps

Coprophagous dogs should be prevented from eating feces for at least 2 weeks before being exposed to booby-trapped feces. As already discussed, a dog's olfactory abilities mitigate the effectiveness of repellents as deterrents. Unless every feces is consistently treated, dogs will simply avoid stools treated with the repellent and look for ones that are not treated. A motion-activated alarm sealed in a zip-lock bag can be rigged so that it is triggered whenever the dog disturbs the stool. A spring-loaded snapper (see *Caps and Snappers*), which causes a small cap to explode when it is disturbed, produces a stronger startle effect and deterrence. Such "stool mines" can be hidden under the feces. The cap is glued to the underside of a 3-inch square of light cardboard. The snapper is loaded, and the card-

board is put on the ground with a stone placed on top to keep it in place, thereby preventing the loaded snapper from kicking up and going off. A fresh stool is placed on top of the arrangement, and telltale signs of cardboard are covered with bits of loose grass and dirt. For safety sake, if not placed on the underside of paper or cardboard, the snapper should be sealed in a zip-lock bag to prevent flying debris from reaching the dog.

Cat droppings are a favorite with some allocoprophagous dogs. To prevent such problems from developing in the first place, dogs should be kept away from litter pans. In some cases, a cat door or small passage cut through the base of the door can provide the cat with access to its litter but block the dog from getting inside the room. Alternatively, the door can be wedged open between two rubber doorstops, leaving an opening wide enough for the cat to get through, but blocking the dog's access. In the case of dogs exhibiting an established appetite, the first step is to prevent access to cat feces for at least 2 weeks before initiating additional training activities. Training efforts should be first performed on leash to establish an avoidance toward the litter pan, followed by the shaker-can procedure described previously. Since booby trapping risks exposing the cat to accidental stimulation, such devices are not appropriate as deterrents. In situations in which the cat's litter pan cannot be kept out of the dog's reach, electronic devices designed to activate an electrical or spray stimulus worn by the dog can be arranged in the vicinity of the litter pan. When the dog approaches too closely, the collar is activated, causing it to rapidly learn to avoid the situation.

Electronic Training

Electronic training can be used efficaciously to control coprophagy refractory to other methods of control. Both remote electrical or spray stimulation can be effective. The aversive stimulus is delivered at the moment the dog reaches for the feces, but, ideally, before it is picked up. To be effective, the training should be staged in various situations where the dog has eaten feces in the past. An electronic collar should only be used to deliver deterrent levels of electrical stimulation after safety training is performed with low levels in the context of reinforcing attention control, recall, quick-sit, stay, and halt-stay exercises (safety training). When used to deter coprophagy, the first exposure in which the electrical stimulus (ES) is paired with feces should be of a sufficient strength to produce an immediate and durable inhibition of the activity. The level of stimulation is determined by the dog's degree of sensitivity and tolerance for the ES. Most dogs rapidly learn to avoid feces following a momentary "nick" (100 to 400 msec) of moderate to strong ES. Increasing the level of electrical stimulation gradually is problematic, since the dog may rapidly habituate to each level of ES, requiring a much more aversive event in the end to achieve the desired deterrence effect. Further, a low-level ES not only may invite or perpetuate an already established approach-avoidance conflict toward feces or risk producing vicious-circle behavior in dogs that are not deterred sufficiently by the ES, but may persist or increase the activity in the presence of the aversive event. Such dogs may learn to eat the feces rapidly, thereby foiling the owner's control efforts. Such a vicious-circle effect is often observed in the case of dogs exhibiting persistent and long-standing coprophagy. As the dog's training progresses, it should be exposed to progressively natural conditions where coprophagy might occur in the owner's absence. At such times, dogs may be tempted to find and eat forbidden feces. A well-timed electrical or spray stimulus delivered from a remote location can be very effective to deter such behavior. Until coprophagy is fully suppressed, the dog should not be let in any situation where it might find feces to eat.

Taste Aversion

Many laboratory studies have demonstrated that animals exposed to some nausea-producing event after eating consequently develop a lasting aversion toward that food item (Garcia et al., 1966). This aversion effect often occurs after a single trial and even after a long delay between eating and exposure to the nausea-producing agent. In some experiments, the nausea-producing agent was not given for

several hours after the animal had eaten the food. Two aspects of taste aversion are extraordinary when compared to how associative learning usually takes place:

1. A strong and lasting aversion may occur after a single exposure.
2. The aversion develops even though the conditioning events are not closely associated with one another in time.

These characteristics are inconsistent with the usual way in which classical conditioning is believed to take place, requiring that conditioned and unconditioned stimuli be repeatedly paired together in a forward and closely contiguous fashion. The discovery of taste aversion had a profound impact on learning theory (see *Prepared Connections: Taste Aversion* in Volume 1, Chapter 5).

Taste aversion is not the same thing as the conditioned repulsion produced by aversive exposure and sensitization to olfactory and gustatory deterrents like hot sauce and commercial spray repellents. For instance, letting a dog first sniff and then squirting a repellent into its mouth is not consistent with recognized protocols for producing taste aversion (Gustavson, 1996). The procedure described by Beaver (1994) may produce significant revulsion, discomfort, and a conditioned repulsion toward the smell and taste of the substance, but despite the procedure's indisputable capacity for producing aversive arousal and sensitization, it will probably not produce a true taste-aversion effect (see *Taste Aversion* in Volume 1, Chapter 6). However, the method may rapidly cause the dog to resent having its muzzle handled or possibly make the dog refuse to let the owner open its mouth in the future, especially if the procedure is performed repeatedly. Along a similar vein, the practice of spraying concentrated or dilute repellents (e.g., lemon or vinegar) into a dog's face as a deterrent for misbehavior should be avoided, since such treatment may irritate the eyes, produce an aversive state that continues long after the unwanted behavior ceases, and perhaps overlap with more acceptable behavior and hinder efforts to reward it. Repeatedly squirting a dog in the face with dilute repellents or even plain water may rapidly cause it to become avoidant toward the owner. Rather than suppressing the unwanted behavior, dogs often learn to perform the target behavior safely outside of the owner's squirting range. In general, olfactory startle conditioning is preferred for developing chemosensory deterrent signals. Once conditioned, the odor can be used to mark forbidden objects, thereby providing the dog with a warning signal helping it to avoid booby traps set up in close association with the marked objects.

Although the efficacy of taste aversion for the treatment of refractory coprophagy remains controversial (see *Tolerance for Nausea and Taste Aversion* in Volume 2, Chapter 9), the "coprophagiac" might be beneficially treated with a series of treatments using a taste-aversion procedure, especially in cases where electronic training is not feasible or appropriate (e.g., dogs exhibiting behavioral counterindications advising against such training). Taste aversion is most effective in cases involving relatively novel food items, but this criterion is not an absolute. According to Gustavson (1996), conditioned taste aversions can be established with flavors that the animal has been repeatedly exposed to over a long period. Common emetics like ipecac and hydrogen peroxide do not perform as effectively as other taste aversion agents, since they may fail to produce nausea. The chemicals used in taste aversion must produce nausea but not necessarily vomiting. A variety of chemical substances can be used to produce nausea in dogs (see Gustavson, 1996). Taste-aversion conditioning can be established by contaminating feces in advance with the selected nauseant or inducing nausea immediately after the dog ingests feces (Table 2.2).

Caution: Taste-aversion conditioning involves administering potentially poisonous and hazardous chemicals to a dog and should be performed only under the advisement and supervision of a veterinarian familiar with the procedure and its risks, including potential adverse behavioral side effects (see Hansen et al., 1997).

PART 5: CRATE TRAINING

Crate training should always be governed by a philosophy of constructive confinement, sig-

nifying that some purposeful training objective is being accomplished by its use. In addition to the criterion of purposeful training, constructive confinement entails that a plan be devised to ensure the eventual release of the puppy or dog from confinement. Without such considerations, the crate can easily become an abusive training tool and a way of life for the dog. Even the most benign and beneficial training tool can become abusive and cruel if excessively or improperly used.

SELECTING A CRATE

Choosing the right crate involves several considerations. Two kinds of crates are typically used for house-training purposes. The most frequently used crate is constructed of heavy-

TABLE. 2.2. Program for persistently coprophagous dogs

1. Coprophagous dogs should receive a thorough veterinary exam to rule out a medical cause.

2. A broad-spectrum digestive enzyme product (e.g., Prozyme) should be considered.

3. Dietary changes may also be helpful, even in cases where the dog is eating a premium diet. Feeding more than once a day may be beneficial in some cases.

4. A determination of when and where the dog eats its stool should be established. Also, information should be recorded regarding the history of the problem. For example, when did the behavior first appear and what sort of things have been tried already to control it?

5. Possible quality-of-life contributing factors should be identified, such as excessive confinement, inadequate play or exercise, environmental stressors, and nutritional deficiencies.

6. Many dogs that exhibit coprophagy also appear to exhibit poor impulse control and attentional abilities. These deficits are addressed through integrated compliance training.

7. The owner is encouraged to walk the dog away from the yard for 2 weeks. During this period, the dog is prevented from approaching or picking up feces by keeping it on a leash and collar (halter type, if necessary). The dog's interest in feces is interrupted with diversionary efforts to capture its attention (e.g., calling its name or squeezing a squeaker) or by using directive signals ("Leave it") and leash prompts sufficient to turn the dog away from the feces. If the dog averts its attention away from the feces, the behavior is bridged ("Good" or click) and reinforced with a food reward. Gradually, the dog is trained to turn from feces and orient on the owner to obtain a food reward.

8. A small biscuit is given to the dog as soon as it leaves the house, and periodically thereafter pieces of biscuits are tossed down for the dog to find in the grass. In addition, the owner can secretly drop biscuits along the way, which the dog is encouraged to find on the way back home. The goal is to encourage the dog to focus on searching for food rather than feces while on walks. As the dog's behavior improves, the number of treats left for it to find can be gradually reduced and faded out. A similar search-and-find game can be set up in the backyard.

9. In cases where diversionary efforts fail to secure the dog's attention, more potent disrupter-type stimuli may be necessary to interrupt the coprophagous interests. A shaker can is often highly effective if thrown at the instant a dog approaches feces. The forceful hissing of the modified compressed-air pump can be highly effective, with the added benefit of blowing the feces out of the dog's reach. The modified compressed-air pump is preferred to excessively loud and startling devises, such as the compressed-air nautical horn.

10. After 2 weeks, various booby traps are introduced to discourage coprophagy when the dog is left alone in the backyard. In general, the yard should be kept clean, with the exception of one or two piles that are left with a booby trap attached to them.

11. In refractory cases, electronic training can be very helpful but should be considered only after the above preliminary efforts have been implemented. Electronic collars delivering electrical or chemical stimulation provide an exact and timely event at a distance—a critical factor affecting the effectiveness of inhibitory training.

12. A conditioned taste-aversion procedure should be considered as a last resort.

gauge metal wire. The crate should be of good quality and sturdy construction. Many dogs have seriously injured themselves attempting to escape from poorly designed and built crates. The best crates are made from panels of 1-inch grid work, but those made with 1- by 3-inch grid panels are usually sufficient for the average puppy. Another type of crate often used for house training is made of plastic and designed for air travel. The plastic travel crate can be made more comfortable by turning it upside down so that the side panels of open grid work are located toward the bottom. This arrangement improves air circulation and gives the puppy a better view of the surroundings while lying down.

An important consideration in choosing a crate is its size. The crate should be big enough to contain an adult dog with enough room for it to stand, lie down comfortably, and turn around. In many cases, this will be a medium to large crate, too big for house-training purposes. Most pet stores stock cage dividers that can be inserted inside the crate to produce the desired dimensions. In addition to a crate, an exercise pen should be obtained. The pen is composed of several interlocking panels that can be adjusted to fit various areas and size needs. It provides greater freedom of movement than provided by the crate, but prevents a puppy from wandering around too much until it is ready for such freedom. If a puppy must be left for extended periods, the crate is kept open and placed inside the holding pen or small puppy-proofed room covered with several layers of newspaper. The puppy should always be provided with a supply of fresh water to meet its needs for the day. Excessive restriction of water does not hasten good elimination habits, but could compromise the puppy's health, perhaps predisposing it to develop urinary tract problems (e.g., cystitis). In addition, puppies deprived of water may drink excessively when finally given an opportunity to drink and then rapidly excrete the excess. Once puppies are successfully crate trained, they can be gradually given more freedom of movement, first in an exercise pen, then the kitchen, and finally the entire house, as they mature and become fully reliable.

Guidelines for Successful Crate Training

Most puppies can learn to tolerate crate confinement with minimum distress, provided that it is introduced properly (Table 2.3). The all-too-common practice of setting up the crate and then shoving the uncooperative puppy inside of it to whine, bark, and to attempt to escape from it only risks conditioning a negative and reactive response toward confinement. Remembering that first impressions are enduring, such practices should be avoided. To produce a more positive and minimally stressful attitude toward crate confinement, several simple precautions should be taken. The crate should be set up in a well-socialized part of the house and kept open for the puppy to explore and enter on its own initiative. Putting soft bedding and toys in and around the crate can help to make it more attractive for a wary puppy. Concealing treats in bedding can further entice a puppy to explore the crate and develop a positive attitude toward it. Fetch games should be played around the crate, occasionally tossing the ball into the crate and encouraging the puppy run after it. Also, highly valued chew toys can be put in the crate at various times during the day, further increasing the attractiveness of the crate. Meals and water can also be given near or inside the crate.

Once a puppy is habituated to the presence of the crate and shows a willingness to enter on its own, further training efforts should be introduced. The following instructions are particularly useful for desensitizing and training the resistant puppy to enter and accept crate confinement.

Step 1

Small bits of an appealing food item are tossed in front or just inside of the crate. This procedure is repeated several times, gradually requiring that the puppy move closer and finally poke its head inside the crate. A familiar rug or blanket should be placed inside the crate to make it more attractive and to muffle potentially startling noises that may be produced when the puppy steps on the pan. As the puppy's confidence improves, the treats are tossed further back in the crate until the

Table 2.3. Constructive crate confinement

Do not crate a puppy wearing a collar.
Place the crate in a well-socialized part of the house.
Ensure that the crate is free of drafts and excessive heat.
Do not confine a puppy in the basement or garage.
Never use crate confinement as a form of punishment.
Never allow children to tease or play with a puppy in a crate.
Never attempt to confine a puppy for periods that exceed its ability to control elimination functions.
Provide the puppy with adequate water for its needs during the day.
Do not allow crate confinement to become a way of life.
Never use the crate as a permanent "steel straitjacket" for unresolved behavior problems.

puppy fully enters. As the puppy turns, it is tossed an additional treat, but it is not prevented from leaving the crate.

Step 2

The treat should be tossed with an exaggerated wave of the arm, with the goal of training the puppy to respond to the movement as a prompt to enter the crate. Occasionally, the gesture is made without tossing a treat, causing the puppy to move into the crate and turn about before it is given the expected reward by hand. Once the puppy reliably responds to the prompt, a vocal signal (e.g., "Crate") can be presented in combination with it. Now, as the puppy enters the crate on signal, it is rewarded and the crate door briefly closed and the puppy given several treats through the crate door. After several seconds, the puppy is released and the procedure repeated, progressively requiring that it stay in the crate for longer periods before being released. The puppy's tolerance can be improved by providing it with a beef bone or some other highly desirable chew toy (e.g., a hollow rubber toy smeared on the inside with peanut butter). It is important to vary the duration of confinement, with graduated exposures, for example: 5, 15, 25, 5, 30, 15, 45, 30, 5 seconds, thereby introducing a beneficial element of positive prediction error and reward. As the puppy learns to enter the crate and accepts brief confinement without protest, longer periods of confinement can be introduced as well as confinement in different household locations (e.g., kitchen, bedroom, and living room), starting with a few seconds and gradually building up to 30 minutes or more, as its tolerance for confinement improves. Puppies should be crated in the bedroom at night and left in the kitchen during the day. In addition to leaving puppies with a tasty toy, the owner should provide the puppy with a scented towel or a few items of soiled clothing (e.g., T-shirt and socks) put inside of a knotted pillow case.

Step 3

Most dogs and puppies accept the aforementioned crate-training process without much anxiousness or resistance. Occasionally, a difficult dog will refuse to enter the crate no matter what efforts are employed to ease its resistance. In such cases, a leash or an active-control line is set up and passed through the opposite crate panel. The puppy or dog is hooked up and prevented from pulling away from the crate and is then slowly maneuvered closer to it through several steps of reward-based training and counterconditioning. Posture-facilitated relaxation (PFR) training may be used to help reduce resistant behavior by training the dog to relax in response to physical restraint (see Appendix C). Ideally, such

dogs should be calmed before entering the crate. In some cases, mild to moderate pulling force may be needed on the control line to get the dog into the crate, but such force should be used only as a last resort. Once in the crate, the dog is repeatedly rewarded with food and reassured with affectionate praise and is immediately released. The procedure is repeated on a control line until the dog shows no resistance or hesitancy about entering the crate. In some cases, a remote feeder can be set up at the opening of the crate, delivering a soft food with a faint safety odor (e.g., orange). As the dog approaches the front of crate, the feeder is activated. Gradually, the feeder is set up farther back in the crate, requiring that the dog enter to obtain the food (see *Systematic Desensitization* in Chapter 3). The feeder enables the trainer to provide a continuous flow of repeated reward events while near the dog or while in another room and watching the dog's behavior via a remote camera.

Some puppies and dogs may protest against confinement with persistent barking and intermittent whining, despite gradual and patient desensitization efforts. In such cases, a squeaker can often be helpful as a means to interrupt barking or other vocalizations. After a brief exposure to the squeaker and clicker in the context of attention and sit-stay training, the stimuli can be used to help control excessive vocalization in the crate. As the puppy orients to the squeak sound and stops barking, the break in vocalizing is bridged with "Good" or a click, and the puppy is thrown a treat, whereupon a differential reinforcement of other behavior (DRO) schedule of reinforcement is introduced, such that a bridge and treat is delivered every so often (e.g., 2 to 5 seconds), provided that the dog does not bark during the DRO period (see *Barking* in Chapter 5). Gradually, the DRO period is increased and the vocal signal "Quiet" is paired with the initiation of every DRO period. Alternatively, the barking can be brought under stimulus control by clicking and tossing the dog a treat on each occasion it barks. As the dog's barking turns to the control of food, the vocal signal "Speak" is timed to occur just before or as the dog begins to bark, followed by the bridge and food reward; conversely, barking off cue is followed by "Quiet" and the loss of reward (response cost). At the earliest opportunity, the trainer should prompt the dog to bark with "Speak" and then bridge and reward the behavior.

As the barking comes under stimulus control, the trainer can initiate time-outs of variable duration in response to barking off cue, thereby linking the loss of social contact with barking and its recovery with not barking. During the time-out, the dog can be ignored in the crate or the trainer can leave the room briefly (e.g. 20 to 30 seconds), requiring that the dog not bark for a brief period before bridging, returning, and rewarding the behavior. As the contingencies become clear to the dog, a drop can is set up and suspended above the crate with a line of dental floss. The drop can is arranged to fall and strike near the crate or on top of it, depending on the dog's temperament and response to such startle. The release of the can is associated with a clipped and subdued "Quiet," perhaps mediating a more rapid inhibitory association while at the same time reducing the level of startle produced by the event. (See the discussion of prepulse inhibition effects covered in *Interrupting Behavior* in Chapter 1). The strength of the event is determined by the height at which the can is dropped and the weight of the can used. In dogs with relatively high-auditory-startle thresholds, a 30-penny can suspended from the ceiling and dropped on top of the crate may be necessary, whereas dogs exhibiting low-auditory-startle thresholds may show an adequately strong response to a seven-penny can dropped 2 feet from the floor. An expedient way to discourage protest vocalizing at bedtime is to say "Quiet" and then to rattle or drop a partially suspended seven-penny shaker can, letting it fall near the crate or on top of it. The shaker should fall forcefully enough to disrupt the behavior but not evoke an excessive startle or fear reaction. If the puppy persists in the barking behavior, the can be dropped from a higher level or replaced by a 30-penny can. As a result of such training, the startle response to the rattling sound is potentiated, causing the puppy to respond to the slightest rattle of the can held by owner or produced by jiggling the suspended drop can. In the case of puppies

overly sensitive to the shaker can, pennies can be put inside of a plastic vitamin bottle, thereby producing a shaker that is less noisy and startling.

Before carrying out such procedures, special care should be taken to make sure that a dog's or puppy's protests are not due to fear of confinement or separation distress. Anxious dogs and puppies need to be handled carefully, reducing their fears of crate confinement gradually by means of gradual exposure, counterconditioning, and PFR training. Crate confinement may significantly exacerbate the distress and emotional reactivity associated with separation distress (Borchelt and Voith, 1982). Separation-reactive dogs sometimes become extremely reactive when left alone in a crate, resulting in the loss of eliminatory control and panic-stricken efforts to escape. Separation-reactive and separation-phobic dogs have seriously injured themselves in their frantic efforts to escape confinement when left alone. Aggressive threats and attacks are not uncommon while an unwilling dog is being forced into a crate. If a puppy's adverse reactivity to confinement is suspected to be due to separation distress, it is imperative that appropriate training be carried out to resolve it (Voith, 2002). To prevent separation-distress-related problems, the puppy should be exposed to separation-desensitization training (see *Attachment and Separation Problems: Puppies* in Chapter 4). Such training should be carried out in parts of the house that hold positive emotional associations for the puppy, e.g., the bedroom or kitchen. Allowing a separation-distressed puppy to whimper and whine for long periods without respite should be avoided. Extended periods of separation distress, especially when occurring under unfamiliar circumstances, may predispose sensitive puppies to become overly reactive to routine separations as adults.

By gradually increasing the separation duration while confined in the crate, the puppy learns to experience the crate as a safe situation predicting the owner's eventual return. The owner should be advised of both the benefits of constructive crate confinement and the potential adverse side effects of excessive confinement. Dogs exposed to long periods of daily crate confinement should receive compensatory exercise, play, and focused attention in the form of reward-based training. A record of the amounts of time (day and night) that the puppy spends in the crate should be kept (Figure 2.7), with the goal of gradually reducing the time spent in crate confinement as training objectives are reached. In summary, constructive crate confinement can be employed as a humane and effective training tool, but it needs to be carefully introduced and never used in the absence of proper training or as an expedient way of life.

Dangers of Excessive Crate Confinement

The advocacy of crate confinement as a way of life, sometimes involving 16 to 18 hours a day, for dogs is inconsistent with their biobehavioral needs and may lead to emotional and behavioral deterioration over time. Some puppies and dogs appear to develop an inordinate attachment with their crates, sometimes preferring to be in their crates rather than with the owner. The daily repeated exposure to the sterile environs of the crate may significantly undermine a developing dog's ability to habituate and adjust to the wider domestic social and physical environment. Although most puppies initially respond to crate confinement as a stressful state of affairs, with repeated exposure stress and aversion gradually give way to an odd attraction to confinement. This gradual attraction to crate confinement appears to occur in association with increased feelings of security, safety, and comfort, rather than increasing levels of vulnerability and insecurity, as one might expect from a condition of entrapment.

Bonding with the Crate

One possible explanation for this paradoxical effect is provided by opponent-process theory (see *Opponent-process Theory and Separation Distress* in Volume 2, Chapter 4). The lengthy exposure to crate confinement provides a situation in which separation distress and other reactions associated with vulnerable isolation

DOG'S NAME: DATE:

SESSION NO.:

DAILY CRATE CONFINEMENT RECORD

DAY	DAY	NIGHT	TOTAL	COMMENTS
1				
2				
3				
4				
5				
6				
7				

FIG. 2.7. Crate confinement chart.

eventually give way to opponent affects of comfort and safety, that is, the exact opposite to the distress and vulnerability initially evoked by crate confinement. Over the course of repeated exposures, the initial adverse reactions to confinement and isolation become weaker and gradually are overshadowed by opponent arousal involving feelings of enhanced security and contentment. In addition to providing emotional arousal incompatible with aversion and efforts to escape, these hypothesized opponent responses may provide a counterconditioning effect, further restraining and reducing aversive arousal asso-

ciated with crate confinement. So far, this opponent-processing analysis does not sound like much of a problem for a dog until one considers how it may interfere with the formation of a satisfying attachment and bond between the owner and the dog. A significant aspect of the attachment object is the provision of comfort and safety, that is, security. For dogs exposed to excessive crate confinement or home environments lacking sufficient consistency and order, their search for comfort and safety may gradually turn from the family and home to the crate. Such dogs may develop a powerful bond and dependency upon the crate as a space of comfort and safety. According to the foregoing opponent-processing analysis, behavioral restraint in association with confinement may result in opponent affects associated with enhanced comfort and safety (nurturing), thereby producing a source of intrinsic reward, security, and contentment that may support passive activities occurring in association with crate confinement. As such, crate confinement minimally meets the three interactive criteria required for establishing a bond: (1) dominance (limit setting by force or threat of force), (2) leadership (prompting and rewarding alternative behavior), and (3) nurturance (comfort and safety obtained in association with deference (criterion 1) and cooperation (criterion 2). Interestingly, when dogs that have been trained to sleep in an isolated part of the house in a crate are allowed to sleep in a bedroom, they often show signs of acute distress, including increased exploratory activity, agitation, and inability to calm down and sleep. In addition, some of these dogs exhibit excessive drooling, become diarrheic, lose bladder control, and show other changes consistent with the behavioral and autonomic sequela associated with separation distress. This reactive behavior is often persistent and requires that the dog be slowly adjusted to sleeping in the bedroom at night.

So, as many owners say, it may be truer than expected that some dogs do, in fact, love their crates, perhaps in some cases more than they love the owner. According to the crate-bond hypothesis, in the absence of a secure and gratifying attachment between the owner and dog, a crate bond may preempt or interfere with the formation of a human-dog bond, possibly setting the stage for the development or exacerbation of a variety of bond-related behavior problems (e.g., separation-distress and owner-directed aggression). Interestingly, in this regard, a subgroup of social aggressors is particularly reactive when in their crates or when disturbed while engaged in activities phenomenally similar to those associated with the security afforded by crate confinement (e.g., resting). Excessive crate confinement may generally sensitize and lower reactive thresholds in predisposed dogs to signals of punishment (threat or loss of comfort) and uninvited social contact, resulting in signs of increased intolerance, irritability, and social incompetence. Excessive crate confinement may cause such dogs to become inordinately sensitive to touch contact and interference while in resting states, possibly because learning conducive to competent impulse control in response to intrusions upon such states of heightened comfort and safety requires direct interaction and tactile contact between the owner and dog, but the crate effectively blocks such interaction and learning. Although the dog may get adequate auditory and visual stimulation while in the crate to offset sensitizing effects of sensory deprivation, tactile stimulation is entirely restricted, providing the basis for a sensitization effect that may increase irritability and intolerance for frustration while lowering aggressive thresholds in response to training. Compensatory tactile stimulation in the form of PFR training is incorporated into the treatment of such dogs in order to provide the necessary direct stimulation to reduce sensitization effects and to organize expectancies incompatible with threat or loss of comfort.

Adverse Effects of Excessive Confinement

Social and environmental adaptations occurring early in life appear to moderate sensorimotor thresholds and homeostatic set points to environmental and social stimuli. Inadequate exposure to varied and complex environmental circumstances and social experiences, traumatic or abusive handling, or exposures lacking sufficient order and consistency may significantly alter reactive fear and

anger thresholds, causing dogs to become progressively reactive (fearful or aggressive) or intolerant of novel or complex demands put upon them. Rearing under laboratory conditions of sensory restriction and social isolation causes a broad spectrum of devastating behavioral effects. Dogs raised to maturity under conditions of social and environment restriction tend to become increasingly excitable, reactive, and disorganized in response to environmental change. Early work carried out by Melzack (1954) identified a cluster of deleterious emotional and cognitive effects resulting from excessive sensory restriction and confinement of developing dogs. These dogs showed a persistent and excessive hyperexcitability to environmental change, reflected in durable changes in brain electrical activity (Melzack and Burns, 1965). The slightest deviation from their accustomed social and environmental conditions resulted in a dramatic increase in activity, often culminating in the expression of whirling fits. In addition to impulse-control dysregulation, restricted dogs often exhibited extreme attention deficits, preventing them from selectively attending to environmental stimuli in an organized way. Instead of exploring and interacting with objects, such dogs raced from one thing to another. Restriction-reared dogs showed a pronounced inability to learn simple avoidance tasks and reacted abnormally to painful stimuli (Melzack and Scott, 1957).

According to Melzack's analysis and model, environmental stimulation is selectively filtered at the "earliest synaptic levels of sensory pathways" in accordance with information derived from past learning—an early articulation of the sensorimotor-gating hypothesis (see *Prediction and Control Expectancies* in Chapter 1). Melzak's theory suggests that the loss of attention and impulse control exhibited by severely restricted dogs is due to a failure of the restrictive environment to provide sufficient opportunity for the dog to acquire a predictive network of associations with which to filter relevant sensory input from irrelevant static. The central nervous system of such dogs appears to crash under the overload of a sensory bombardment resulting from the restricted dog's inability to competently filter out relevant from irrelevant sensory data and to contextualize it in conformity with past memories and experiences (prediction and control expectancies). As the result of adaptive learning, the dog acquires a cognitive and emotional interface of prediction-control expectancies that rapidly appraises the significance of sensory input via a comparator function sensitive to the detection of discrepancies between what the dog expects to occur and what actually occurs (see *Prediction Error and Adaptation* in Chapter 10). Relevant information is selected from irrelevant information based upon the input's significance to operative control incentives ongoing at the moment. Sensory input that deviates from established control expectancies, resulting in surprise (reward) or disappointment (punishment), is of particular importance for the development of organized behavior. Information resulting in surprise and the avoidance of disappointment is preferentially sought in the process of learning. In addition to prediction errors related to control incentives and expectancy modules (e.g., surprise), dogs are also sensitive to discrepancies occurring in association with novelty and startle. However, instead of reacting to novelty or startle with disorganized output as in the case of Melzack's restrictively reared dogs, well-trained and socialized dogs respond to such stimuli with appropriate hesitation and curiosity before choosing a course of action. Finally, unlike restricted dogs, which respond to aversive stimuli without a clear appreciation of the event's significance as a threat, well-adjusted dogs respond to unconditioned aversive stimuli with forbearance, escape, or aggression, as appropriate and most likely to control the event successfully, perhaps in accord with a rapid cost-benefit analysis of available control modules and probable outcomes.

Even in cases where puppies have been previously well socialized, they may become progressively reactive to environmental stimuli and handling if kept under conditions of sensory and social deprivation (Fox, 1974). In such cases, sensory restriction and social isolation appear to degrade or reverse the benefits of early socialization. Dogs need a balance of sensory input to achieve behavioral homeostasis. Depending on tempera-

ment traits and early experience, environments producing too little or too much stimulation may produce an adverse effect. Environments producing too little stimulation and variety may predispose dogs to develop behavioral adjustment problems associated with intensified efforts to increase stimulation and gratification. Dogs presenting with hyperactivity are often affected by stimulation-seeking excesses, especially attention-seeking behavior that appears to continue unabated, even after the dogs get large amounts of social contact and stimulation. Environments producing too much stimulation and variety may produce changes in behavior in the direction of compulsive excesses, that is, behavior aimed at modulating excessive stimulation. Most dogs are organized with a sufficient degree of behavioral plasticity to adapt to environmental changes involving increases or decreases in stimulation, on the one hand, and increases or decreases in frustration or anxiety, on the other (adaptive types). These stable and adaptive dogs are differentiated along an extraversion-introversion continuum: the sanguine (stable extravert) and phlegmatic (stable introvert). However, some dogs, as the result genetic predisposition, adverse early experiences, or neurotogenic learning may become progressively reactive to increases or decreases in environmental stimulation and changes producing frustration and anxiety (reactive types). These unstable and reactive dogs are also differentiated along an extraversion-introversion continuum: the choleric (unstable extravert) and the melancholic (unstable introvert) (see *Experimental Neurosis* in Volume 1, Chapter 9). Whereas adaptive types are preferentially sensitive to signals of reward (sanguine) or signals of avoidance (phlegmatic), reactive types are preferentially sensitive to loss of comfort (choleric) and loss of safety (melancholic). Finally, adaptive types shown an affinity for activating the seeking and social engagement systems, whereas reactive types show an affinity for activating the anger and fear emotional command systems.

Choleric (c-type) dogs may be particularly vulnerable to the adverse effects of environmental deprivation, excessive crate confinement, and a lack of daily training and play. Failure to provide c-type dogs (high sensitivity for frustration/low anger and attack thresholds) with appropriate daily stimulation and training conducive to organized and balanced attention and impulse control may rapidly elevate frustration levels while at the same time lowering aggression thresholds. C-type dogs may be susceptible to the sensitizing effects of restricted tactile stimulation and crate-related conflict in association with signals of loss and frustration. Such dogs may develop reactive elaborations in response to innocuous interference and loss of comfort while resting in favorite locations (see *Bonding with the Crate)*. C-type dogs may also show an increased susceptibility to separation-distress reactivity as the result of sensitization occurring in association crate-related conflict and frustration. The separation-reactive c-type dog may attack as the owner leaves the house. On the other hand, melancholic-type (m-type) dogs may be more vulnerable to environmental situations or change producing too much stimulation or arousal, perhaps gradually activating behaviors aimed a reducing it (e.g., compulsive licking). Whereas c-types may become increasing reactive in response to stimulation levels falling below homeostatic set points, m-types (high sensitivity for anxiety/low threshold for fear and escape) may be affected by intolerance for stimulation that exceeds homeostatic set points. As the result of restricted tactile stimulation and conflict produced in association with excessive crate confinement and anxiety, m-type dogs may be more prone to develop reactive aggressive elaborations in response to innocuous threat signals. M-type dogs may be particularly susceptible to separation reactivity occurring in association with anxiety. Dogs presenting with an admixture of c-type and m-type propensities (high sensitivity to frustration and anxiety combined with low anger and low fear thresholds) may be prone to panic-related aggression and separation-distress reactions. Both c-type and m-type dogs tend to *react* in response to environmental changes producing frustration and anxiety, whereas sanguine (s-type) and phlegmatic (p-type) dogs tend to *adapt* to environmental changes producing frustration and anxiety. However, under conditions of excessive crate confinement,

neglect (absence of training, exercise, and play), and environmental conditions lacking consistency and order, s-type and p-type dogs may become progressively unstable in the direction of c- and m-types.

The role of crate confinement in the etiology of behavior problems has not been scientifically established, but empirical impressions and logic dictate that it probably plays an important role in the development or exacerbation of many adjustment problems. In the absence of daily socialization and training, organized behavior may gradually degrade, causing a dog to lose its ability to respond competently to social signals. Even more significantly, however, under the influence of disorderly social circumstances, lacking sufficient predictability and controllability to elaborate viable prediction-control expectancies, the dog may be rendered particularly vulnerable to the stressful effects of excessive crate confinement and social isolation. Such dogs may fall victim to the disorganizing effects of inconsistent punishment and reward, causing them to become progressively incompetent and reactive to ambivalent social interaction. Given the organizing effects of learning on the development of competent attention and impulse control, it is reasonable hypothesize that a converse effect follows when dogs are exposed to excessive confinement and isolation (marginalization) in combination with disorderly or deranged social interaction—conditions that place dogs at the greatest risk of developing adjustment problems. In contrast, dogs that are integrated into a home-life situation consisting of orderly interactions are much less likely to experience an exacerbation of predisposing influences or develop an adjustment problem. Given the ubiquitous presence of crate confinement and its potential for producing stress, environmental and social deprivation, and abuse, it is odd that so little research is currently available with which to evaluate its potential role in the development of adjustment problems. Clearly, given the adverse behavioral and physiological effects associated with kenneling (Hubrecht et al., 1992; Clark et al., 1997; Coppinger and Zuccotti, 1999) and evidence of an increased risk of relinquishment in situations where dogs spend most of the day in a crate (Patronek, 1996), sufficient grounds exist to justify a serious examination of the potential role of crate confinement in the etiology of behavior problems (see *Deprivation and Trauma* in Volume 2, Chapter 2). Hopefully, in the future, researchers performing relevant cynopraxic studies will routinely collect such data to help flesh out the roles of excessive confinement and social-interaction deficiencies in the development of adjustment problems.

Freedom Reflex, Loss of Control, and Restraint

Healthy dogs are endowed with a robust freedom reflex, and they accept crate confinement and other forms of restraint (e.g., halter control) begrudgingly, frequently only after a significant struggle. As such, crate confinement is not only a condition of restraint, it also represents a loss of control. The loss of control over significant events is a necessary condition for producing experimental neurosis; however, the critical factor for producing neurotic disturbances is restraint (see *Liddell: The Cornell Experiments* in Volume 1, Chapter 9). Under conditions of restraint, exposure to inescapable aversive stimulation exerts pronounced behavioral and cognitive disturbances (see *Learned Helplessness* in Volume 1, Chapter 9). The condition of crate confinement satisfies both of the requirements for inducing neurotic elaborations. The chronic inhibition of the canine freedom reflex by daily crating is probably a source of significant conflict and stress for dogs and, when occurring in combination with a social environment lacking consistency and controllability, a convergence of potent behavior-disorganizing influences may be unleashed. If exposed to crate confinement without counterconditioning, dogs and puppies often protest vigorously with distress vocalizations and persistent efforts to escape, such as scratching and biting at the cage walls. The dog's initial resistance and resentment slowly yield and, after a variable period of diminishing effort, the dog may slip into a state of depressed resignation. The dog's ability to accept such restraint may not occur without a significant risk of harm, how-

ever. In postpubertal and adult dogs, the sorts of behavior prompting owners to crate their dogs often arises from a failure to establish consistent communication and control efforts, thereby only compounding difficulties, making things much worse, and postponing the proper resolution of the problem.

Ethological Rationalizations of Crate Confinement

A common rationalization for crate confinement is based on a questionable assumption that the dog is a denning animal, naturally prepared and well adapted for life in a crate. Despite the widespread circulation of this belief, there exists little factual evidence to support it. The belief that the dog is a denning animal is flawed in several ways, as Borchelt (1984) points out:

> The average dog book refers to dogs as "den dwelling" animals and presumes that confining imparts a feeling of security to a puppy. Dogs, in fact, are not den dwelling animals, although in a variety of canids the dam will construct a nest (often underground) for the pups. The nest is a defense against predators and protection against inclement weather. The pups use it as a "home base" from which they explore, investigate and play. There is no door on the den which encloses the pups for many hours. In many cases, "crate training" a puppy will attenuate vocalization and elimination, and prevent chewing. Unfortunately, it may also exacerbate these behaviours and sometimes leads to psychosomatic signs or hyperactivity elicited by the owner's return … Crating or other confinement (e.g., isolating in a small room) is highly likely to exacerbate a separation problem once it has occurred for any length of time, or for a puppy with a previous attachment and separation problem. (171–172)

Although wolves do prepare dens to whelp and rear their young, they do not use such places as general sleeping or resting areas. In fact, as early as 10 to 12 weeks of age, wolf pups are generally moved from den locations to rendezvous sites ("open-air kindergartens") where they are left while adults go on hunting sorties (Young and Goodman, 1944/1964; Allen, 1979). Corbett (1995) has reported that dingoes exhibit similar den habits, moving pups from den sites at about 8 weeks of age to various rendezvous areas, usually rock ledges. Ironically, this is precisely the time when most domestic puppies are first introduced to their "four-sided" dens. Wolves normally make their beds under conifer trees or on rock outcroppings where they have an unobstructed view of the surrounding terrain (Murie, 1944/1987). After the pack has satisfied itself on a kill, they often expend a great deal of energy to find open areas to lie down and sleep (Mech, 1970):

> After feeding intensively, wolves then seek a suitable spot in which to rest and sleep. If the sun is shining and the wind is light, they prefer open areas such as ridge tops or expanses of ice, and they will travel several miles to get to such places. There they sprawl out on their sides or bellies for several hours. During windy, snowy weather, they curl up in protected areas such as beneath evergreen trees, where they remain for long periods. (190–191)

The preceding discussion is not intended to eschew crate confinement altogether or to persuade dog owners not to use crate confinement as a responsible training tool; it is intended, however, to balance the promotional propaganda of advocates recommending crate confinement as an unabashedly positive thing, a virtual utopian condition for the dog, satisfying the dog's "den instinct," and similar misunderstandings and exaggerations. Crate advocates routinely espouse crate confinement as a way of life for family dogs, without fully appreciating the harmful side effects that may occur as the result of excessive restriction and social isolation. The convenience of crate confinement and the social permission afforded by glib rationalizations has beguiled many dog owners into believing the myth wholesale. For people convinced that their dog loves its crate, keeping it confined for 16 to 18 hours a day in a laundry room is not such a bad thing: after all, the dog is a "den" animal. As a result, many dog owners have come to regard the crate as a panacea for controlling undesirable behavior. Instead of dedicating the necessary time and effort needed to socialize and train the dog properly, the crate has become a steel straightjacket for controlling untreated behavior problems.

Contrary to the popular hype, the crate is not a "home," nor is it a "den": it is a place of confinement. In essence, the crate mechanically suppresses a dog's behavior, restrains the dog's freedom of movement, and imposes a loss of control; as such, crate confinement is a condition of punishment (loss of reward) that can be highly aversive and stressful for a dog reactive to such restraint. Successful crate training requires gradual exposure and counterconditioning. Perhaps, in the future, a manufacturer will develop an inexpensive feeder and manipulandum that can be attached to the crate and interfaced with a program conducive to sustaining a dog's interest, thereby helping the dog to form a more positive association with the crate. Performing PFR training before crating a dog may help it to relax, especially if a well-conditioned olfactory-signature odor is left behind to maintain the effect. Introducing the crate slowly and making it comfortable with soft or tasty toys and objects scented with the owner's odor can help to reduce adverse side effects, but it will not eliminate them. In the case of dogs that require long-term crate confinement, appropriate compensatory stimulation and activities should be provided. The cynopraxic process is dedicated to nurturing and supporting the dog's capacity for freedom by means of training and play. As such, crate confinement is viewed as an aversive technique and used as any other aversive technique, that is, as a necessary evil toward a greater good (see *Cynopraxis and Ethics* in Chapter 10) (Table 2.4). The goal of crate training should be to get the dog out of the crate as soon as possible, and to use the crate as little as possible in the service of training and space-management objectives.

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Table 2.4. Summary of adverse effects of excessive crate confinement

Excessive confinement may result in deleterious sensory and behavioral deprivation.
Social and environmental deprivation provides motivational setting events for hyperactive and intrusive social excesses.
Influences of confinement-related frustration may generalize over numerous behavior systems (e.g., social, appetitive, and exploratory).
Upon release from confinement, undesirable social behavior may be strongly reinforced and integrated into the dog's postconfinement repertoire.
Excessive confinement is stressful for a highly sociable and dependent family dog.
Improper crate training may exacerbate separation distress.
Four-sided confinement (a trap) is a natural condition of vulnerability and may activate survival mechanisms associated with biological adversity.
Excessive confinement interferes with normal training, adjustment, and adaptive functioning.
Excessive confinement may socially marginalize a dog within the family system.
Since the condition of confinement is inescapable, symptoms of learned helplessness may develop especially in the case of dogs experiencing a highly level of aversive arousal while confined to a crate.
Frantic efforts to escape from the crate may result in serious injuries to the dog or its death.
Repeatedly forcing a dog into a crate may cause it to become aggressively reactive at such times.

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3

Fears and Phobias

PART 1: ORIENTATION AND BASIC CONCEPTS

Working with fears and phobias requires considerable insight and technical skill. First and foremost, cynopraxic counseling and training activities should cultivate owner understanding and management strategies, as well as introduce and demonstrate procedures aimed at gradually reducing a dog's fear and fear-related behavior. Many common fears can be successfully treated; however, some phobias are highly resistant or intractable and may show only limited improvement despite the most conscientious training efforts. In such cases, counseling efforts should emphasize management strategies designed to help an

owner cope with the challenges of living with a fearful dog.

COPING WITH FEAR

Keeping in mind that fear is primarily under the control of Pavlovian influences (Maren, 2001; see also *Classical Conditioning and Fear* in Volume 1, Chapter 6), it is unlikely that emotional responses associated with fear (e.g., trembling and panting) are significantly influenced by reward and punishment. Nonetheless, instrumental escape and avoidance efforts associated with fearful arousal may strongly influence fear-related behavior. The way fearful behavior is managed has a direct effect on fearful arousal and its perpetuation. For example, although vocal encouragement and petting can have a calming and beneficial effect on a moderately fearful dog, such comforting efforts may also inadvertently reinforce fear-related behavior by providing the dog with a shield of safety, behind which it can escape or avoid fearful situations. Although owner attitudes and anxiety do not appear to play a particularly prominent role in the etiology and maintenance of major phobias (see *Owner Mental States and Behavior Problems* in Volume 2, Chapter 10), an owner's apprehensions about a dog's behavior when approaching fear-eliciting objects or situations may significantly influence therapeutic outcomes. In such circumstances, the dog is not likely to attribute the owner's worry to *itself* or to its behavior, but will more likely interpret the owner's worry as something bearing on the developing situation, perhaps increasing its own wariness. By adopting a confident attitude, excessive worry and apprehension about a dog's behavior can be avoided. Helping the owner to establish basic control over the dog's behavior is one of the best ways to instill confidence. As the owner's control over the dog improves, he or she will naturally feel more secure and relaxed when confronting potentially disruptive situations with the dog. Similarly, dogs under control appear to be more secure and confident, seeming to equate the owner's enhanced control over them with a safer environment.

Obviously, effective behavior therapy and training entail that both the owner and the dog learn how to cope more effectively with fear. Dogs cope with aversive situations through a variety of cognitive, behavioral, and physiological means. Appreciating the interaction between fearful behaviors and underlying physiological changes is extremely important (see *Autonomic Nervous System-mediated Concomitants of Fear* in Volume 1, Chapter 3). High levels of stress associated with fearful arousal may interfere with adaptive behavior, resulting in persistent maladaptive coping strategies that impede the extinction of fear. Emotionally stressful situations appear to contribute to the development of phobias and their expression (Jacobs and Nadel, 1985). For example, dogs exhibiting separation anxiety appear to be more prone to develop storm-related fears, perhaps as the result of an increased vulnerability to fear-eliciting stimuli stemming from emotional stress. Similarly, separation anxiety may present comorbidly with thunder phobias, requiring that both problems be addressed together. Frank and colleagues (2000) have reported that 40% of dogs with thunder and noise phobias also exhibit concomitant symptoms of separation anxiety. The threshold-lowering effects of stress can also be observed in dogs fearful of strangers and unfamiliar dogs.

When confronted with aversive situations, dogs typically cope by engaging in activities that serve to reduce the danger:

- Escape from eliciting stimulus (flee)
- Displace the source of aversive stimulation (fight)
- Increase vigilance or searching behavior (flirt)
- Wait for the situation to change (freeze)
- Tolerate or accept the situation (forbear)

Constructive coping strategies involve behavioral efforts designed to render an unfamiliar or threatening environment more predictable and controllable. Many dogs are fearful of unfamiliar things and situations because they are uncertain about their ability to predict and control them, often operating under the influence of toxic expectancies or dysfunctional learning experiences. Such dogs may *expect to fail* when faced with difficult or threatening situations (adversity). Expecting to fail when confronted with unfamiliar or

adverse situations is a potent source of anxiety and frustration. Anxiety and frustration are the emotional corollaries of situations in which unfamiliarity or detrimental cognitive and learning influences undermine a dog's ability to predict and control critical events effectively (see *Anxiety* in Volume 2, Chapter 3). As an aversive or threatening situation proves unpredictable and uncontrollable, anxiety and frustration correspondingly increase and impede adaptive behavior, perhaps causing the dog to become progressively hyperreactive (choleric type) or hyporeactive (melancholic type). However, as the result of experiences in which a dog has learned that it can successfully control aversive situations and threats, it naturally acquires an enhanced sense of competency and confidence, learning to *expect to succeed* when faced with adversity (see *Efficacy Expectancies* in Volume 2, Chapter 3). Under the influence of positive efficacy expectancies, the dog is more likely to approach uncertain situations in a more confident, success-oriented, and adaptive way (sanguine and phlegmatic types). Cynopraxic behavior therapy consists of reward-based procedures aimed at reducing adverse behavioral stress (anxiety and frustration) while at the same time training the dog to cope more competently and confidently with uncertain and unfamiliar situations.

Basic Training and Fear

Many dogs exhibiting excessive fear or generalized anxiety appear to do so under the influence of a negative expectancy with respect to their ability to cope with aversive events effectively (see *Efficacy Expectancies* in Volume 2, Chapter 3). Threatening situations present significant prediction and control problems for fearful dogs. Following exposure to aversive events under highly controlled and predictable conditions, dogs appear to learn how to cope more competently with their presentation, showing less distress and physiological arousal than when such events occur uncontrollably or unpredictably (see *Fear and Peripheral Endocrine Arousal Systems*). As a dog's competency and confidence improves, it becomes progressively relaxed. Relaxation naturally competes with fear and anxiety, providing a significant counterconditioning influence over fearful arousal.

Competency, Confidence, and Relaxation

A chief objective in the management of fear is to promote an expectancy of success in dogs. Intensive reward-based basic training is a constructive starting point for developing such a positive attitude. The improved communication and cooperation attained by attention therapy and basic training provide numerous benefits for fearful dogs. A probable factor explaining this improvement is the high degree of consistency and order that such training affords. The enhanced control and prediction associated with basic training translate into increased competence, relaxation, and expectancies of comfort and safety. In addition to establishing instrumental control, various appetitive and ludic conditioned emotional responses are simultaneously formed between signals, responses, and outcomes that have been repeatedly linked and rewarded with affection, food, and play in the process of training. As the result of orderly and repetitious patterns of basic training, dogs learn to cope more competently and confidently with social and environmental pressures placed upon them. Basic training provides an island of order and safety that can help ground anxious and fearful dogs and provide a stable platform for graduated counterconditioning and response-prevention procedures. As standard expectancies are established, positive prediction error and dissonance effects can be used to further enhance training and therapy efforts.

The cynopraxic training process renders a dog's behavior more predictable and controllable; however, to the extent that it achieves such an effect, the dog is empowered with an enhanced ability to predict and control the trainer (see *Hitting and Missing the Mark* in Chapter 10). The combined emotional changes associated with reward and enhanced competence make the dog more receptive to approaching the surrounding environment in a correspondingly more confident and relaxed way, an extremely important transition in the management of fear. As the result of consistent and orderly reward-based training activities,

insecure dogs appear to learn gradually to respond to the wider social and physical environment as though it were organized by similar rules. As training proceeds and a dog's trust grows toward the owner and the surrounding environment, playful modal activities may be educed and integrated into the training process to further extend and generalize the dog's adjustment, making it more natural and durable. Play and relaxation are the emotional antipodes of fear and anxiety. Learning to play in situations previously evoking fear is facilitated by first bringing trained behavior under the control of play rewards, gradually linking the various signals, prompts, responses, and so forth, with ludic associations. Play and reward-based training mediate a potent comfort/safety bias that is incompatible with fearful inhibition, indecision, and vigilance. By means of gradually transferring training and play activities into feared or unfamiliar situations, more competent and confident coping behavior is organized and integrated, while incompatible appetitive, social, and ludic associations antagonize or abolish situational fear and anxiety.

Sit-Stay Training and Relaxation

Reward-based attention therapy and basic training involving sit-stay and down-stay conditioning is often performed in advance of counterconditioning and desensitization efforts. During such training, appetitive and social affects elicited by the presentation of rewards may be associatively linked with contextual cues, signals, and the rewarded response itself (V. L. Voith, personal communication, 2002). Attention therapy and basic training can be particularly useful in the case of counterconditioning procedures that require dogs to remain as relaxed as possible in one place while attenuated fear-eliciting stimuli are presented and antagonized by stronger incompatible stimuli. In addition to providing an emotionally conducive platform for the reduction of fear via counterconditioning, basic training enhances a dog's ability to control significant events competently, thereby promoting expectancies conducive to enhanced confidence, relaxation, and feelings of safety (see *Benefits of Cynopraxic Training* in Chapter 1).

Victoria Voith's Sit-Stay Program was developed with this objective in mind (see Appendix A). While working with David Tuber in the late 1960s and early 1970s in Ohio, Voith found that training dogs to sit and stay afforded several therapeutic benefits for the treatment of behavior problems (Voith, personal communication, 2002). Owners presenting dogs for behavior therapy were taught how to train them to sit and stay by using a reward-only training technique. The owner-trainers were explicitly instructed not to use a stern voice or forceful means and were urged to limit training to social and appetitive rewards only. Sit-stay training not only taught dogs to sit still but also appeared to teach them how to relax. She noticed after a week of sit-stay training that many of the problems exhibited appeared to improve without any other treatment and regardless of the type of problem presented. In addition, Voith noted that the bond between the dog and the owner had changed in positive ways. Several factors may have played a contributory role in mediating these rapid behavioral and relationship changes, but Voith speculates that two general influences were probably most important:

1. Less aversive interaction between the dog and the owner may have decreased the stress, anxiety, and frustration underlying the presenting problems.
2. Enhanced mutual attentiveness occurring in association with reward-based training may have produced significant changes of affect and mood incompatible with stress, anxiety, and frustration.

Voith also observed that many owners showed attitude changes that may have also contributed to a more positive response to treatment:

- They learned how dogs learn.
- They showed increased pride in their dog.
- They became more enthusiastic and committed to the therapy process.
- They showed an enhanced appreciation of the dog's intelligence and abilities.
- They seemed less distressed and more optimistic about the resolution of their dog's problem.

Voith subsequently composed an autotutorial sit-stay program that she gave clients as a handout. The program is included in Appendix A, with some modifications. The autotutorial organizes the training process into a progression of sit-stay skills of increasing duration, distance, and difficulty. In addition, during sit-stay training, performance criteria are presented in accordance with an errorless learning format, whereby dogs are prepared for each new requirement in advance, with the goal of minimizing stressful errors and maximizing efficient acquisition.

The emphasis placed on errorless learning and positive reinforcement in the sit-stay protocol raises a number of questions with respect to the differential effects and side effects of reward and punishment on emotional behavior and stress. At least one study raises a concern about potential adverse side effects associated with inhibitory stay training (Wilhelmj et al., 1953) (see *Liddell: The Cornell Experiments* in Volume 1, Chapter 9). The researchers found that it took several weeks to months of intensive inhibitory training to quiet dogs enough to get accurate basal blood pressure readings. As a result of such training, however, many dogs showed a potent hypertensive response as well as signs of exaggerated emotional reactivity toward trivial environmental changes (e.g., strangers and noises) and changes of routine. The amount of training given to the dogs appeared to affect the severity of the dog's response adversely:

> The degree of training seems to be of considerable importance in that highly trained and conditioned animals give much greater blood pressure responses to trivial changes in the experimental environment and procedures than animals that are less highly trained. (1953:394)

In addition to the duration of training, a dog's temperament strongly influenced how it responded to inhibitory training. Dogs with stable temperaments were relatively unaffected by intensive inhibitory training, whereas dogs exhibiting unstable and emotionally reactive temperaments were most harmfully affected by it—findings consistent with Pavlov's observations concerning the vulnerability of choleric-type and melancholic-type dogs to neurotic elaborations. On a side note, these findings underscore the importance of selecting dogs for practical training that are highly stable to begin with, since emotional reactivity and instability may not improve with training, but may in fact worsen over time under the influence of demanding inhibitory training. Highly monotonous and repetitive inhibitory training may be particularly damaging to emotionally reactive and unstable dogs as the result of overstraining inhibitory attentional and impulse-control mechanisms (see *Locus of Neurotogenesis* in Volume 1, Chapter 9). Further, these findings point to the possibility that certain forms of intensive sit-stay training and restraint may be problematic with respect to long-term behavior-therapy efforts aimed at reducing fear and enhancing a dog's tolerance for environmental stimulation. These undesirable effects may exert an especially pronounced deteriorative effect in emotionally reactive dogs, such as those with behavior problems in associated with anxiety, fear, and aggression. Unfortunately, the report does not contain a description of the procedures used to train dogs for blood-pressure testing, leaving significant questions up for debate concerning its relevance.

The sit-stay program designed by Voith has not been implicated in producing similar adverse side effects and probably does not risk doing so, but it remains to be rigorously tested and evaluated for both beneficial and adverse side effects. A major difference in the case of dogs trained in accordance with the sit-stay protocol is they are not compelled by restraint to stay; that is, they perform the response by virtue of self-imposed restraint—they want to sit and stay. The freedom of choice appears to exert a protective effect on the development of neurotic elaborations (Liddell, 1956). However, such freedom is not only a characteristic of food training but present in virtually all forms of standardized animal training:

> In the case of the seeing-eye dog or the performing seal in the circus the self-imposed restraint developed through training *enhances* their effective and skilled behavior. Although they perform at signal, they do so with zest. Spontaneity and initiative are not quelled. Such animals are not brow-beaten. Freedom of action after the work period remains unimpaired. (Liddell, 1956:35)

Without choices, a dog's adaptation to significant events may be thwarted, causing it to become rapidly inhibited or impulsively reactive. Provided that the dog can escape or avoid aversive events, a choice remains available to it, thereby minimizing adverse side effects. The most common and chronic obstruction to making choices effectively is a lack of order in the occurrence and controllability of significant training events and outcomes. Events lacking predictability and controllability are disabling to a dog essentially because they make effective choices impossible for it. The sit-stay protocol combines a freedom to choose in the context of highly predictable and controllable signals and outcomes—ideal conditions for appetitive learning.

Any behavioral procedure that is capable of producing a significant benefit should also be capable of producing adverse side effects, if used improperly. The notion that training with positive reinforcement only produces less stress and promotes beneficial emotional changes during inhibitory sit-stay training remains a hypothesis that is overdue for experimental evaluation and validation. Although the sit-stay program appears to be useful and generally beneficial, the placebo effect is a powerful and pervasive influence that can profoundly alter the perceived efficacy of behavioral procedures—an effect that can be excluded only by controlled experimentation and clinical trials. Given the widespread use of the sit-stay program in the treatment of behavior problems, it is critical that appropriate tests be carried out to confirm its efficacy in order to justify claims attributed to its use. The dramatic and in some cases almost miraculous effects anecdotally and clinically attributed to the protocol suggest that sit-stay training ought to produce a robust effect that distinguishes it from other ways of training dogs to sit and stay. The sit-stay program should also outperform procedures in which appetitive and social rewards are presented on a noncontingent basis.

A starting point for such research might be to obtain baseline behavioral and physiological indices (e.g., cortisol, blood pressure, and heart rate) and then to compare that data with measures taken at week 1, week 2, and so forth, thereby obtaining a tentative within-subject indication of stress-related behavioral changes occurring as the result of the implementation of reward-only training. In addition to short-term effects, follow-up data should be collected. Given evidence of change, additional experiments might be performed to test whether reward-only training was specifically the agent of change rather than other causes incidental to sit-stay training [e.g., increased positive attention (more petting and food rewards)], increased orderliness of interaction between the owner and the dog, or the discontinuation of aversive and provocative stimulation.

Many practitioners using the sit-stay protocol take for granted that reward-only training produces superior therapeutic effects, but does it? If it does, why does such a benefit occur? If the reward-only strategy is selected as the result of welfare or humane considerations, then that underlying intent should be made clear at the outset and not mixed with efficacy considerations, except insofar as they can be demonstrated. In other words, if the basis for using a reward-only strategy is a matter of enhanced efficacy and therapeutic outcome, then appropriate data should be provided in support of the rationale together with outcome assessments showing a superior effect. To address these issues, a series of experiments need to be performed to evaluate how sit-stay training with food and petting only, in accordance with the errorless format, performs in comparison with other methods of training that use different procedures and combine varying proportions of food, petting, manual restraint, mild leash prompting, and so forth. These comparisons should be based on established behavioral and physiological indicators of stress (e.g., cortisol and blood pressure) and emotional reactivity. For example, one experiment might involve training two groups of dogs yoked together under identical training conditions, except that one group is given intensive sit-stay conditioning in accordance with the errorless sit-stay protocol, while the other group receives an equal number of voice commands, bouts of petting, and treats, but randomly distributed over the training session on a noncontingent basis (i.e., the rewards and signals are unlinked to a sit or stay response). This sort of study could be

modified and performed as a clinical single-subject reversal design, whereby the effects of sit-stay training could be systematically compared with noncontingent reward or attention therapy without a sit or stay response (i.e., conditioning of an orienting, attending, or following response). For example, dogs could be divided into two groups, with one receiving 1 week of sit-stay training followed by 1 week of attention training, whereas the second group is reversed, with dogs receiving 1 week of attention training followed by 1 week of sit-stay training. In cases where a larger number of dogs are available, a randomized, placebo-controlled, reversal design could be used, thereby obtaining the added power of a group-statistical analysis.

Another set of experiments could be performed to compare the errorless and reward-only group with two experimental groups using varying amounts of rewards, prompting, and restraint together with a control group. In one of the experimental groups (restraint), dogs might be trained with manual restraint, voice commands and hand signals to sit and stay, with leash prompting in combination with contingent appetitive and social rewards presented to reinforce sitting and staying. A second restraint group might consist of dogs trained to sit and stay in a similar way, but with appetitive and social rewards presented on a randomized noncontingent basis in accordance with a yoking procedure, whereby the same rewards given to the reward-only group are also given to the restraint group, regardless of what they are doing at the time of a reward's delivery. Finally, dogs in the control group receive no sit-stay training but are also yoked to the reward-only group, thereby receiving an identical treatment in terms of signals and reward stimulation. Additional studies could be performed to evaluate and compare the reward-only sit-stay and down-stay procedures with other techniques of sit-stay training in order to assess its relative efficacy, practical viability for use in applied settings, and relative ability to provide a conducive platform for counterconditioning. Given the rather simple and straightforward nature of such behavior studies and the widespread use of the sit-stay protocol in the professional treatment of frequently serious and dangerous behavior problems, it is rather extraordinary that no significant studies exist to date that evaluate its rationale and claims of clinical efficacy.

Neurobiological Substrates of Anxiety and Fear

A major adverse influence affecting a dog's ability to cope with fear-eliciting stimuli is early sensitization of neural circuits mediating the fight-flight response (see *Stress and Flight or Fight Reactions* in Chapter 4). Emotional stressors affecting the mother during gestation, together with excessively stressful postnatal conditions, may exert a lifelong detrimental influence on the way dogs cope with fear- and anger-provoking situations (see *Maternal Separation and Stress* in Chapter 4). Together, heredity and adverse prenatal and postnatal stressors may destine many young dogs to express reactive traits and tendencies before they open their eyes, requiring that such dogs obtain early preventive treatment to improve their ability to develop an adaptive coping style and to minimize the long-term effects of stressful sensitization to the fight-flight system. Stress-sensitized dogs may show a lowered threshold to startle and fear, rapidly learn fear-eliciting associations, and show a deficient ability to extinguish fearful associations once they are established. Knowing how fear is processed, learned, stored, and extinguished at the neural level provides useful insight into how to prevent and treat it effectively.

Startle and Fear Circuits

Startling auditory events are processed by a direct pathway between the thalamus and amygdala and an indirect pathway between the thalamus, prefrontal cortex, hippocampus, and amygdala (Figure 3.1). The direct pathway between the thalamus and amygdala serves to reflexively orient dogs toward the source of stimulation and prepare them for emergency action, whereas cortical and hippocampal inputs provide more specific information about the eliciting stimulus and its contextual significance (LeDoux, 1996) (see *Neurobiology of Fear* in Volume 1, Chapter 3). Of significance to sound-related phobias, the

lateral amygdala contains neurons that are highly sensitive to acoustical stimulation. Some of these neurons are prone to rapid habituation and dishabituation, perhaps performing an important fear-related function by detecting novelty and change. Other groups of amygdala neurons are dedicated to loud noises, perhaps mediating unconditioned startle responses to threatening noises such as thunder (Bordi and LeDoux, 1992) (see *Habituating and Consistently Responsive Neurons* in Volume 1, Chapter 3). These various neurons may undergo modification as the result of learning, resulting in threshold and tuning changes that may make them selectively responsive to certain auditory stimuli and not others.

Afferent pathways from the auditory cortex and thalamus to the lateral amygdala use the excitatory neurotransmitter glutamate. Within the lateral amygdala, these glutamate tracts form synaptic connections with inhibitory GABAergic interneurons. GABA (gamma-aminobutyric acid) is known to play an important role in the modulation of fear and anxiety (see *Glutamate and GABA* in Volume 1, Chapter 3). GABA-mediated inhibition within the lateral amygdala is of tremendous interest with respect to noise-related events triggering fear. Excessive sensitivity to fear-eliciting stimuli may reflect a deficiency of GABAergic-related inhibition over glutamatergic neurons. The inhibitory modulation of glutamatergic networks generating fear and anxiety appears to be mediated by serotonin receptors expressed on GABAergic interneurons (Stutzmann and LeDoux, 1998). Serotonin (5-hydroxytryptamine or 5-HT) modu-

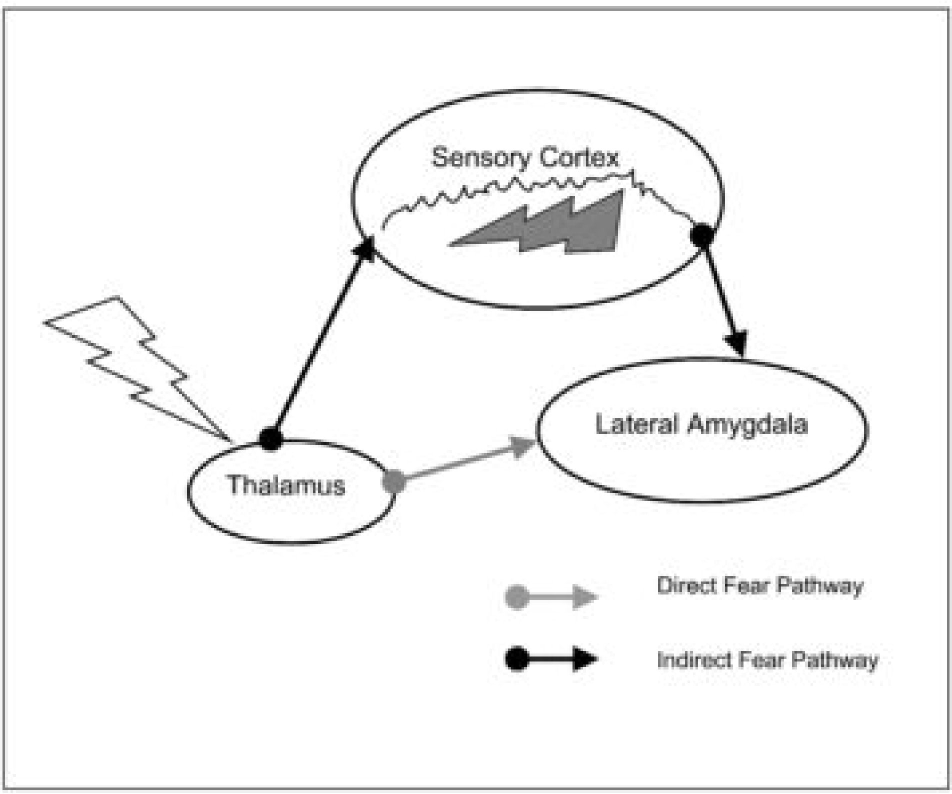

FIG. 3.1. Both direct (thalamo-amygdala pathway) and indirect (cortico-amygdala pathway) fear pathways converge on the amygdala. The direct pathway produces rapid orientation and preparation for emergency action, whereas the indirect pathway provides additional specific and contextual information about the eliciting stimulus.

lates anxiety via the 5-HT_{1A} receptor, the absence of which renders affected animals vulnerable to increased anxiety-related behavior (Hendricks et al., 2002). Medications targeting GABA and 5-HT activity are frequently used separately or together to treat refractory noise and thunder phobias (see *Pharmacological Control of Anxiety and Fear*). Fear-related glutamatergic activity is also modulated in the context of fear conditioning by gastrin-releasing peptide (GRP), a glutamatergic cotransmitter that binds to GRP-receptor sites located on GABAergic interneurons (Shumyatsky et al., 2002). GRP activates a GABAergic interneuron-mediated negative (inhibitory)-feedback effect on glutamatergic neurons. In addition to dampening fearful arousal, GRP, via this signaling network, appears to exert an amygdala-specific inhibitory effect on conditioned-fear learning. Genetically modified mice, not expressing GRP receptors, show an increased responsiveness to fear conditioning, enhanced long-term potentiation, and stronger long-term fear memory (Shumyatsky et al., 2002).

Circulating glucocorticoids also appear to play a prominent role in the serotonergic inhibition of cortical and thalamic sensory inputs to the amygdala. In fact, the inhibitory effects of serotonin appear to *depend* on the presence of glucocorticoids (corticosterone) (Stutzmann et al., 1998). The production of circulating glucocorticoids is under the regulatory control of the hypothalamic-pituitary-adrenal (HPA) axis. Adrenocorticotropic hormone (ACTH) stimulates the adrenal cortex to release glucocorticoids (cortisol and corticosterone). ACTH is released into the bloodstream by the pituitary in response to corticotropin-releasing factor (CRF)—a neural hormone secreted by the paraventricular nucleus (PVN) of the hypothalamus in response to stress. In addition to releasing ACTH, the pituitary gland releases ß-endorphin under CRF stimulation. Circulating adrenal glucocorticoids exert a restraining negative feedback effect on the hypothalamus, causing it to decrease CRF release, thus completing the HPA axis (see *Hypothalamus* in Volume 1, Chapter 3). Adrenal hormones also affect hypothalamic CRF output via opponent feedback effects exerted by the amygdala and hippocampus (LeDoux, 1996). Under the influence of glucocorticoids, the hippocampus restrains CRF, whereas the amygdala stimulates the PVN to produce more (see *Neural Stress Management System and Fear Conditioning* in Volume 1, Chapter 3).

In addition to initiating the chain of events leading to the secretion of glucocorticoids, CRF appears to coordinate a cascade of stress-related neural events that contribute to the expression of anxiety and fear. The CRF system projects to the locus coeruleus, where it exerts an excitatory influence on the production of norepinephrine (NE). Increased NE turnover is associated with increased emotional reactivity, hypervigilance, and disturbances of attention and concentration abilities (Valentino and Aston-Jones, 1995)—states consistent with clinical anxiety and fear. NE dysregulation has been clinically implicated in the development of various human anxiety disorders, posttraumatic stress disorder, and depression (Heim and Nemeroff, 1999). CRF and NE appear to interact within the central nucleus of the amygdala, with NE stimulating CRF release. Microinjections of CRF antagonists into the central amygdala significantly attenuate fear-related arousal and behavior (Koob, 1999). CRF also plays a focal regulatory role in the production and release of 5-HT. Kirby and colleagues (2000) found that CRF produces a dose-dependent, biphasic effect on 5-HT-producing neurons in dorsal raphe bodies. At high doses, perhaps, comparable to the CRF levels present during acute stress, CRF excites 5-HT-producing neurons. However, at low doses, perhaps, comparable to CRF levels associated with chronic stress, CRF exerts an inhibitory effect on 5-HT production. Price and colleagues (1998) have reported a similar biphasic effect of CRF on 5-HT activity. CRF microinjections in the striatum also affect 5-HT release in a dose-dependent manner. Again, they found that high doses of CRF increase extracellular 5-HT levels, whereas low doses decrease 5-HT levels. In both studies, the predominant effect of CRF on 5-HT activity was inhibitory. These findings suggest the possibility that acute stress associated with fear may initially increase 5-HT production and release, whereas chronic stress associated with anxiety

may gradually decrease 5-HT activity. A CRF-mediated increase in NE turnover together with a reduction in 5-HT activity may impede the brain's ability to modulate stressful sensory inputs effectively and regulate behavioral responses to it. NE and 5-HT dysregulation appears to play a functional role in a wide gamut of dog behavior disorders and problems (see *Neurobiology of Behavior and Learning* in Volume 1, Chapter 3). In addition to dysregulating NE and 5-HT activity, excessive stress appears to perturb prefrontal dopaminergic functions responsible for mediating refined adaptation, selective attention, and the control of emotional behavior (Arnsten, 1998). Dopamine imbalances have been implicated in a variety of stress-related psychiatric disorders (Pani et al., 2000) and animal behavior problems (Dodman and Shuster, 1998).

The localization of long-term memories produced by fear conditioning is a complex and controversial area of research. Several brain areas appear to play contributing roles, but the actual areas dedicated to fear memories have not been completely determined. Although Pavlovian fear conditioning appears to be localized in the amygdala and depends on long-term changes localized there (Rogan et al., 1997; Maren, 2001; Shumyatsky et al., 2002), memories are also formed in other parts of the brain providing complementary fear-related functions. For example, the contextual information and motor habits associated with the expression of fear appear to be stored in the hippocampus and striatum, respectively (LeDoux, 2000). Whereas the amygdala plays a significant role in the consolidation of memories associated with inhibitory avoidance conditioning (Wilensky et al., 2000), it does not appear to modulate or inhibit (e.g., extinguish) conditioned-fear responses once they have been established. Conditioned fear originating in the amygdala is dependent on inhibitory influences originating outside of the amygdala, especially the prefrontal cortex (LeDoux, 1996). Finally, conditioned fear and anxiety appear to result from neuronal long-term potentiation (LTP) mediated by glutamate. LTP produces excitatory presynaptic changes in cortical and thalamic neurons that, in turn, exert enduring effects on postsynaptic electrical activity in the amygdala (Tsvetkov et al., 2002). GRP appears to exert an inhibitory effect over LTP and the formation of long-term fear memories (Shumyatsky, 2002).

Once established, emotional fear memories are highly durable and may be permanent, but their expression can be restrained by extinction memories formed in the prefrontal cortex (Milad and Quirk, 2002). Training activity that successfully mediates extinction may do so by converting operative fear-related establishing operations into fear-restraining abolishing operations, whereby subcortical fear memories localized in the amygdala and thereabouts are actively inhibited and prevented from triggering fearful arousal and escape/avoidance behavior in response to the conditioned-fear stimulus. Along with revised prediction-control expectancies developed in the context of graded interactive exposure and other cynopraxic behavior-therapy efforts, emotional establishing operations are calibrated to match fear-incompatible control incentives and goals, instrumental control modules, and adaptive modal strategies (*Basic Postulates, Units, Processes, and Mechanisms* in Chapter 10). These various cognitive and emotional regulatory changes mediated by behavior therapy are theorized to take place on a preconscious level, involving a complex neural network of interacting sensory, motor, emotional, and cognitive comparator loci, and positive- and negative-feedback systems located throughout the brain, which are coordinated by executive memories (i.e., prediction-control expectancies and establishing/abolishing operations) (see *Neural Comparator Systems* in Chapter 10).

The resolution of fear-related problems depends on the integrity of executive control functions to disconfirm fear-related expectancies and to activate relevant abolishing operations as well as to consolidate new expectancies and establishing operations incompatible with fear. Fears stemming from precognitive stages of development or resulting from sensitization may dodge executive control due to the absence of prediction-control functional expectancies and establishing operations. The executive control of fear appears to depend on

the formation of prefrontal linkages with subcortical fear circuits operating at the time in which the fear memories are formed. Fears acquired independently of executive control appear to evade executive modulation until adequate prediction-control expectancies and calibrated emotional establishing operations are integrated to regulate fearful arousal to guide functional behavioral adjustments.

The interaction between the amygdala and the cortex is bidirectional, with the amygdala exerting a significant influence on the way that fear is processed at the cortical level. In addition to modulating cortical activity, the activation of subcortical arousal systems by the amygdala indirectly affects the quality of cortical functioning (LeDoux, 2000). As a result of this close interaction, executive control systems localized in the prefrontal cortex may be adversely affected by chronic fear and persistent anxiety. Executive control systems process expectancies and contextual information associated with fear-eliciting situations, playing a major role in the way dogs respond to fear and, most importantly with respect to behavior therapy, the way in which they respond to extinction and counterconditioning efforts (see *Extinction of Conditioned Fear* in Volume 1, Chapter 3). Under the influence of chronic fear and stress, executive functions localized in the prefrontal cortex may become disturbed and hinder the dog's ability to cope effectively with conditioned fear, as well as interfere with its extinction (see *Stress-related Influences on Cortical Functions* in Volume 1, Chapter 3). In addition, the accumulated effects of acute and chronic stress may make dogs more sensitive and reactive to fear-eliciting stimulation, emphasizing the importance of early intervention. As dogs age, some may become more susceptible to noise and thunder phobias, perhaps reflecting an age-related biological degeneration of critical brain areas dedicated to the modulation of conditioned fearful arousal (see *Hippocampal and Higher Cortical Influences* in Volume 1, Chapter 3).

Fear and Peripheral Endocrine Arousal Systems

Peripheral cortisol appears to provide an objective measure of stress in dogs (Beerda et al., 1998), especially when combined with relevant behavioral changes indicative of stress. Individual differences clearly exist with respect to the way animals cope and recover from stressful experience, with some showing a rapid recovery and others recovering more slowly (García and Armario, 2001). Putatively, the ideal pattern is robust glucocorticoid release followed by rapid recovery. Stress-prone animals exhibit impaired HPA-axis recovery, with increased levels of circulating glucocorticoid hormones present long after the termination of aversive exposure. Interestingly, nervous and normal pointer dogs do not appear to exhibit significant differences with respect to HPA activity (Klein et al., 1990), a finding that appears to conflict with earlier anatomic work that found that nervous dogs had larger (hypertrophied) adrenal glands (see *Nervous Pointers* in Volume 1, Chapter 5). Nervous pointers were found to be more prone to develop severe mange, suggesting the possibility of stress-related immunosuppression. In addition, nervous pointers are typically smaller than normal counterparts, exhibiting significantly lower plasma levels of insulin-like growth factor, suggesting that chronic stress associated with fear may affect the hypothalamic-growth hormone axis (Uhde et al., 1992).

As the result of Pavlovian conditioning, adrenal glucocorticoid release can be modulated (increased or decreased) by conditioned stimuli and contextual cues paired with appetitive and aversive stimulation (Stanton and Levine, 1988). A conditioned stimulus paired with aversive stimulation tends to increase glucocorticoid output, whereas a conditioned stimulus paired with an attractive appetitive or social stimulus tends to decrease glucocorticoid output and appears to stimulate the release of oxytocin and other neuropeptides conducive to the mobilization of an antistress response (see *Origin of Reactive versus Adaptive Coping Styles* in Chapter 4). Instrumental learning also appears to have a significant effect on adrenal glucocorticoid activity and blood pressure. Dogs exposed to uncontrollable aversive events exhibit a significant increase of cortisol output in comparison to dogs that are able to escape stimulation (Dess et al., 1983). Likewise, the signaled loss of

control in the context of instrumental avoidance training causes a pronounced increase in cortisol output (Houser and Paré, 1974). In addition to HPA-activity changes, the loss of instrumental control produces a significant elevation in blood pressure. Gaebelein and colleagues (1977) found that the blood pressure of dogs remained unchanged during signaled avoidance conditioning, but increased significantly when they were exposed to unsignaled avoidance conditioning. In general, dogs show a strong ability to cope and to adapt to stressful situations, as revealed by a steady decrease in cortisol output over time (Hennessy et al., 1997) and ability to adapt under suboptimal conditions (Campbell et al., 1988). Kuhn and colleagues (1991) found that both cortisol and corticosterone levels where significantly increased in dogs during transportation, but rapidly returned to baseline levels overnight once the destination was reached.

Under the activating influence of fear, various emotional, behavioral, and physiological adjustments are rapidly recruited for emergency action. Many of the coordinated responses associated with learned fear and acute fearful arousal, including startle, freezing, and fight-flight behavior, are orchestrated by the central amygdala (Van de Kar and Blair, 1999) (Figure 3.2). As previously discussed, the central amygdala also exerts a positive (excitatory) feedback effect on the release of CRF by the hypothalamus. In addition to triggering HPA-axis activity, the hypothalamus supports emergency emotional and behavioral adjustments occasioned by fear by mediating conducive physiological changes. In concert with the brainstem (medulla) and spinal preganglionic neurons, the hypothalamus activates the sympathetic division of the autonomic nervous system (ANS). Sympathetic autonomic activation produces global bodily changes in preparation for emergency action, including the secretion of epinephrine (adrenaline) by the adrenal medulla. Epinephrine complements and sustains various fear-related bodily changes set into movement by direct sympathetic arousal, including increased heart and respiratory rates and skeletal-muscle tonus and readiness for action. Epinephrine also appears to play a significant role in the learning of fear (McGaugh, 1990; Costa-Miserachs et al., 1994) and the extinction of fear (Richardson et al., 1988). Signs of fear, such as panting and pupillary dilation, are under the control of the sympathetic division of the ANS (see *Hypothalamus* in Volume 1, Chapter 3). Sympathetic activation is followed by parasympathetic deactivation, resulting in a return to homeostatic balance. Parasympathetic opponent or rebound effects are commonly seen subsequent to fearful arousal, increased salivation, pupillary constriction, bradycardia, and loss of bladder control.

PHARMACOLOGICAL CONTROL OF ANXIETY AND FEAR

Hart and Hart (1985) have described the benzodiazepine diazepam as the drug of choice for the management of a variety of fear conditions. A significant advantage of diazepam is its rapid assimilation and attainment of therapeutically effective levels. Cohen (1981) reported that diazepam attained peak levels of effectiveness in the dog within 30 minutes. A major drawback, however, is that diazepam is very rapidly metabolized and cleared from a dog's bloodstream in a manner that far exceeds the metabolism rates observed in humans. To maintain therapeutic concentrations, dogs may require three doses per day (Löscher and Frey, 1981). Other benzodiazepines (e.g., clorazepate and alprazolam) have become more popular, in part, because they are much longer acting—a significant advantage in the treatment of fear-related problems. Benzodiazepines are not usually recommended for fearful dogs exhibiting comorbid aggression, because they tend to exert a disinhibitory effect on the fight/flight system and may lower aggression thresholds (Woolpy and Ginsburg, 1967; Marder, 1991; Dodman and Arrington, 2000). Finally, diazepam is prone to produce pronounced ataxia in dogs, including unsteady coordination and falling down, side effects that many dog owners find unacceptable. Ataxia may be particularly problematic in excitable dogs, because they may injure themselves while attempting to escape a fearful situation. With respect to diazepam's effect on escape behav-

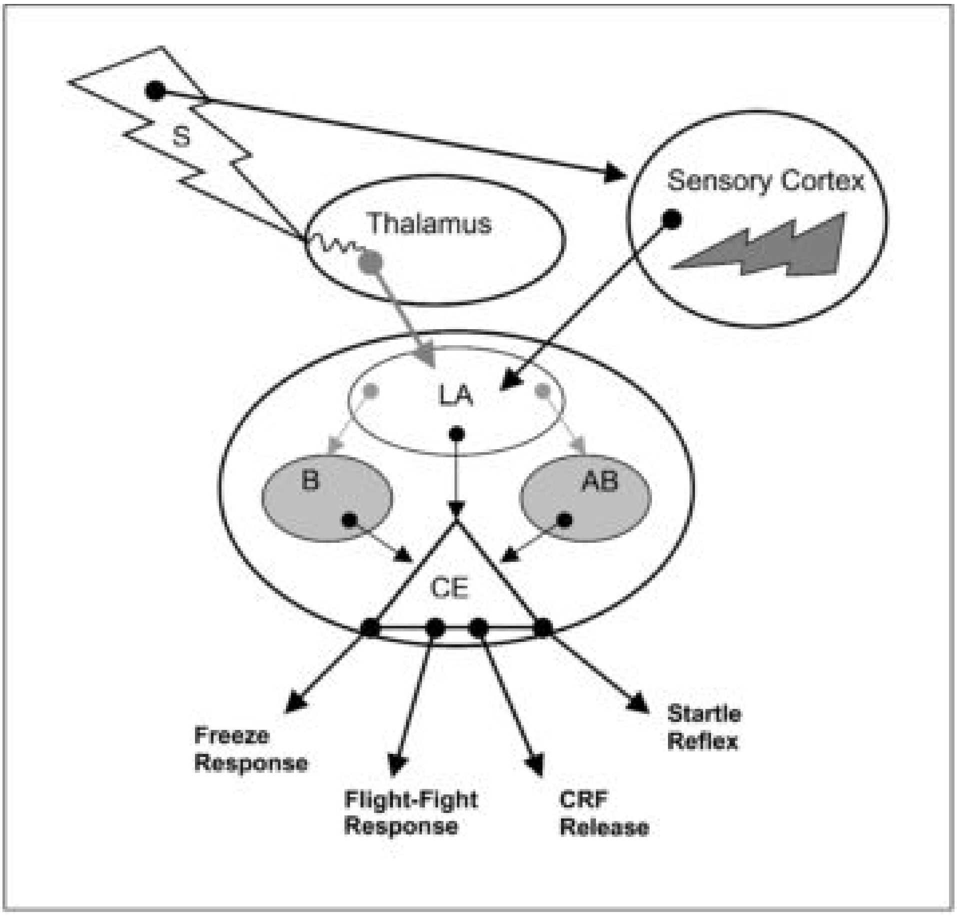

FIG. 3.2. The amygdala orchestrates the expression of a number of emotional and behavioral responses to fear via various neural connections, including the startle reflex (reticulopontis caudalis), freeze response (central gray), CRF release (paraventricular hypothalamus), and flight-fight responses. AB, accessory basal nucleus; B, basal nucleus; CE, central nucleus; CRF, corticotropin-releasing factor; and LA, lateral nucleus. After Ledoux (1996).

ior, Cohen (1981) found that it, in comparison to other drugs tested (haloperidol, chlorpromazine, thioridazine, and clozapine), exhibited a minimum effectiveness for inhibiting escape behavior at dosages not also producing pronounced ataxia.

Desensitization effects produced under the influence of benzodiazepines may be state dependent, with improvements lasting only so long as the dog is under the influence of medication. The transfer of beneficial desensitization and counterconditioning effects may be facilitated by gradually tapering off the medication (Swonger and Constantine, 1983). Although tapering may help in some cases, a number of reports indicate that tapering procedures may not work in the case of highly fearful animals. For example, Woolpy and Ginsburg (1967) performed a series of experiments with various anxiolytic drugs (e.g., librium, chlorpromazine, and reserpine) in an effort to help socialize human-avoidant wolves. Although tranquilization had pronounced effects on social approach behavior, compressing into 4 days what took several months to achieve without medication, the

therapeutic benefits were short lived and fully disappeared after the drugs were withdrawn:

> Thus far we have not been able to bring any animal to the fully socialized stage under drug or to maintain it at the most positive approach stage achieved under drug after the drug has been withdrawn, regardless of the variations in the tapering-off process. (362)

They also found that tranquilized wolves tended to be more aggressive and failed to offer typical threat displays, making them more dangerous to handle (disinhibition). Tranquilized wolves also did not exhibit the tail wagging, mouthing, and other social expressions shown by well-socialized counterparts. Similarly, in the case of nervous Catahoula and pointer dogs, benzodiazepines (e.g., diazepam, chlordiazepoxide, and oxazepam) facilitated the acquisition and performance of a simple instrumental bar-press task, but when the medication was discontinued the bar-press behavior was lost (Murphree, 1974). Neither gradual nor rapid discontinuation of medication had a significant effect on transferability of the bar-press task from the drugged state to the nondrugged state. Puppies receiving chlorpromazine for several weeks (weeks 8 to 15) after being socially isolated from weeks 3 to 7 showed little or no lasting social or psychological effects, even though medicated puppies appeared to extinguish trained avoidance responses more rapidly than unmedicated controls (Fuller et al., 1960). Yet, in the case of puppies exposed to longer periods of isolation (weeks 4 to 15), chlorpromazine appeared to exert a highly beneficial and lasting effect (Fuller and Clark, 1966). The researchers found that chlorpromazine in combination with handling significantly reduced the emotional arousal and behavioral disorganization (emergence stress) associated with environmental and social exposure after long-term isolation, indicating that such drug treatment, when combined with forced social contact (response prevention), might totally eliminate the postisolation syndrome in puppies expressing a "robust genotype" (Fuller and Clark, 1966:257) [see *Environmental Adaptation (3 to 16 Weeks)* in Volume 1, Chapter 2].

The experimental treatment of genetically influenced canine behavior disorders with tricyclic antidepressants has produced mixed results. Iorio and colleagues (1983) have described a strain of beagles exhibiting global behavioral disturbances. Among other things, these dogs exhibited deficits in their ability to form social attachments, appeared withdrawn and depressed (stooped posture, reduced activity, decreased alertness), and showed avoidance and failure to look at or make eye contact with human observers. Both imipramine and amitriptyline produced an improvement in 50% of the dogs after a 2-week delay, whereas benzodiazepines produced more immediate beneficial results. Dogs medicated with tricyclic antidepressants maintained improvement over the 24 hours between doses. After the medication was withdrawn, the abnormal behavior rapidly returned to pretreatment baseline levels (Iorio et al., 1983). Imipramine given daily for 4 weeks to nervous pointer dogs was ineffective against the social avoidance and fearful behavior exhibited by these dogs (Tancer et al., 1990). Chronic stress in association with fear and phobias appears to induce adverse neurobiological changes and dysregulatory influences over numerous neurotransmitter systems. Because 5-HT produces widespread neuromodulatory effects over subsystems relevant to the control of fear and the management of stress, serotonergic medications are frequently used in psychiatry to orchestrate far-reaching neurobiological changes to ameliorate depression and several anxiety-related disorders exhibited by human patients (Vaswani et al., 2003). Selective serotonin-reuptake inhibitors (SSRIs) and tricyclic antidepressants are also often prescribed by veterinary behaviorists in an effort to enhance 5-HT activity and to improve neural functions relevant to the reduction of anxiety and fear. These medications target serotonergic neurons, causing them to inhibit the reuptake of 5-HT from the synaptic cleft.

Currently, the most common medications used to treat anxiety and fear are clomipramine and fluoxetine, alone or in combination with a variety of benzodiazepines. Stein and colleagues (1994) have reported that clomipramine may be useful in

the treatment of fear-related problems in dogs. All of the dogs treated were unresponsive to behavior therapy alone or in combination with anxiolytic medications (diazepam and clorazepate) or a tricyclic antidepressant lacking potent 5-HT-reuptake inhibitory effects (amitriptyline). Clomipramine proved effective in all of the dogs treated (N = 5), with three showing improvement during the first week and additional treatment benefits accruing over time. Veterinary treatment protocols combining 5-HT-enhancing medications, such as clomipramine, together with long-lasting benzodiazepines (alprazolam) appear to be effective in treating thunderstorm phobias (Crowell-Davis et al., 2001). The efficacy of this combined approach to control pathological fears (e.g., thunder phobias) may be the result of a synergistic effect produced by SSRIs and benzodiazepines on the GABAergic modulation of glutamate afferent acoustical inputs projecting to the lateral amygdala. In addition, SSRIs probably mediate a modulatory effect over central amygdala efferent tracts by way of a serotonergic mechanism. Also, experimental evidence suggests that alprazolam may exert part of its anti-anxiety effect by decreasing CRF activity in the locus coeruleus, a brain site where CRF stimulates NE production (Arborelius et al., 1999)—a neurotransmitter believed to play a prominent role in the expression of anxiety and fear. Melatonin and amitriptyline have been used in combination to treat one case involving intense and generalized fearful arousal occurring in response to various noises, including such diverse auditory stimuli as birdsong and thunder (Aronson, 1999). The combination was reported effective for delivering a rapid reduction in noise-related fear. The positive therapeutic response was subsequently maintained by treating the dog with melatonin alone, which proved effective for controlling noise-related fears, including the fear of thunder occurring over subsequent seasons of storm activity. Aronson suggests that the rapid onset of fear reduction and the ability of melatonin to maintain the effect in the absence of amitriptyline make it likely that melatonin played a prominent role in mediating the effect. Dodman (1999) has also reported some success using melatonin to control noise-related fear (see *Pharmacological Control of Separation Distress* in Chapter 4).

Numerous physiological processes, including odor-conditioned histamine release in guinea pigs (Russell et al., 1984), odor-conditioned insulin release in rats (Woods et al., 1977), taste-conditioned immunomodulation (Ader and Cohen, 1985), and conditioned modulation of adrenal glucocorticoid release (Stanton and Levine, 1988), are influenced by classical conditioning. The sensitivity of physiological and endocrine functions to conditioning suggests the possibility that the effects of certain medications used to control fear could be harnessed or potentiated by means of Pavlovian conditioning. Many of the anxiolytic drugs prescribed to control fear exhibit rather rapid onset, producing global emotional and behavioral effects incompatible with fear. Usually such medications are given to dogs without consideration for contextual cuing and other potential conditioning effects. Perhaps by explicitly pairing a novel olfactory stimulus with medication a conditioned association between the odor and context could be established with the tranquilizing effects of the medication (Otto and Giardino, 2001). After repeated trials, the presentation of the odor alone might elicit some of the tranquilizing effects of the medication. Similarly, after repeated dosing in a certain location (e.g., a crate), a dog may learn to accept confinement there more readily.

Note: The foregoing information is provided for educational purposes only. If considering the use of medications to control or manage a behavior problem, the reader should consult with a veterinarian familiar with the use of drugs for such purposes in order to obtain diagnostic criteria, specific dosages, and medical advice concerning potential adverse side effects and interactions with other drugs.

EXERCISE AND DIET

A program of daily exercise is highly recommended for fearful dogs. Daily exercise appears to help balance neurotransmitter activity and restore efficient functioning of the brain's stress-management system (see *Exercise and the Neuroeconomy of Stress* in

Volume 1, Chapter 3). Rueter and Jacobs (1996) have reported that behavioral activity, especially rhythmic activities (e.g., walking, running, and swimming), exert a significant effect on 5-HT levels in various parts of the forebrain associated with fear conditioning, including the hippocampus, striatum, amygdala, and prefrontal cortex. The benefit of daily and long-term exercise is a heightened sense of well-being and an improved ability to cope with stressful arousal. Family dogs typically receive woefully inadequate routine exercise and may obtain significant benefits from walking, jogging, energetic play activities, and the like. Exercise activities should include taking the dog to unfamiliar places as is appropriate and safe. Another important basic consideration in the management of chronically stressed dogs is diet. Fearful dogs should be fed a high-quality, balanced diet. Hennessy (2001) found that giving shelter dogs an enhanced diet containing highly digestible protein and fat, produced a beneficial effect on HPA activity and behavioral responses to stressful situations, an effect that was augmented by brief periods of daily human contact and petting. Some evidence suggests that the manipulation of dietary protein and carbohydrate proportions (low protein/high carbohydrate) may increase the availability of tryptophan for 5-HT biosynthesis, perhaps helping to modulate certain fear-related problems associated with a 5-HT deficiency (see *Diet and the Enhancement of Serotonin Production* in Volume 1, Chapter 3). Dogs under the influence of chronic fear and stress may benefit from dietary supplementation with fish oils containing omega-3 fatty acids (Freeman, 2000). Foods enriched with the antioxidants vitamin E and alpha-lipoic acid (found in spinach) may ameliorate fear-related cognitive impairments associated with chronic stress and aging in some dogs (Packer et al. 1997; Milgram et al., 2002). Supplementation with soy protein offers another potentially useful, although currently unproven, dietary change that may exert a modulatory influence on anxiety. Soy meal contains estrogen-mimicking phytoestrogens. Phytoestrogens exert a number of behavioral and physiological effects, including the ability to bind selectively with and modulate estrogen receptors. When evaluated in an elevated maze test, rats fed soy diets rich in phytoestrogens showed a marked reduction of anxiety in comparison to rats fed a diet low in phytoestrogens (Lund and Lephart, 2001). Diets rich in soy phytoestrogens have also been shown to enhance learning and memory significantly in both animals and people (File et al., 2001; Lephart et al., 2002). The value of soy-rich diets for the management of fear and anxiety in dogs has not yet been evaluated, but the accumulating experimental evidence warrants appropriate investigation and trials for potential clinical efficacy.

A variety of herbal supplements have been found to exert anti-anxiety effects in animals and people (see *Herbal Preparations* in Chapter 4). Passionflower (*Passiflora incarnata*) may have some value in the treatment of certain anxiety disorders. Various parts of the passionflower have been shown to exert an anxiolytic effect comparable to diazepam in mice (Dhawan et al., 2001). A randomized, double-blinded, and placebo-controlled trial found that passionflower extract performed comparably with oxazepam in the treatment of generalized anxiety in human patients (Akhondzadeh et al., 2001). Another potential herbal remedy for managing anxiety in dogs that should receive future attention with respect to efficacy and safety is kava kava (*Piper methysticum*) extract. Kava kava has been demonstrated to be efficacious as an anti-anxiety agent in several double-blinded and placebo-controlled trials to reduce anxiety in people (Pittler and Ernst, 2000). Finally, a valerian-lemon balm combination has been shown to provide a soporific effect and an improved quality of sleep in human patients (Cerny and Schmid, 1999). The combination was well tolerated and produced minimal side effects. Perhaps such a combination might offer a useful benefit for the management of certain anxiety and fear-related problems or provide a mild sedative effect to encourage sleeping in restless dogs.

Numerous anecdotes and testimonials have attributed a calming and emotion-stabilizing effect to flower-essence remedies. One veterinary author has described potent physiological effects observed as the result of administering flower essences, even the man-

agement of bleeding during surgery: "If bleeding occurs during surgery, the Trauma formula, given every 30 seconds until the situation is resolved, can be very useful" (Blake, 1998:581). The value of flower remedies for the modification of emotional or physiological states has not been scientifically demonstrated in animals. With respect to anti-anxiety effects in people, two double-blinded, randomized, and placebo-controlled studies have been performed to evaluate the effect of various combinations of flower essences to control test-taking anxiety in students (Armstrong and Ernst, 2001; Walach et al., 2001). Neither study showed any benefit, above placebo, attributable to combinations of flower remedies for the control of test-taking anxiety.

Note: Since herbal and dietary changes may produce adverse side effects if not properly dosed or balanced, such manipulations aimed at producing behavioral changes should be carried under the advisement and guidance a veterinarian.

Active and Passive Contingency Management Strategies

The etiology and expression of fear-related behavior problems are influenced by interacting contingencies of classical and instrumental conditioning. An important aspect of the behavioral control of fear is to identify and manage these influential contingencies systematically, with the goals of reducing undesirable fearful behavior while at the same time increasing a dog's competence and confidence in the presence of fear-eliciting stimuli. Contingency management can be roughly characterized as a process in which relevant eliciting stimuli, responses, and response-produced consequences are carefully identified and then systematically manipulated to attain specific behavioral objectives. Behavioral output can be managed by both active and passive contingency management techniques. Active contingency management (ACM) refers to the collection of methods used to reliably produce overt and emotional behaviors incompatible with fear. These procedures include a wide gamut of common behavior modification and therapy procedures. In addition to actively manipulating associative and consequent contingencies, fear-related problems are passively managed by controlling a dog's contact with and immediate response to fear-evoking situations. Passive contingency management (PCM) refers to procedures that serve two complementary functions: (1) decrease uncontrolled exposure to evocative situations and (2) prevent or block evoked behavior by various means, including direct restraint and confinement. For example, in the first case, owners are instructed to avoid activities and situations that have evoked fearful behavior in the past, at least until appropriate procedures are in place to minimize fear and to help reduce its future expression. In the second case, procedures are introduced to block fearful avoidance and escape behavior. There are significant interactions between active and passive contingency management procedures, with most behavior-therapy techniques incorporating both active and passive components.

Habituation, Sensitization, and Preventive-exposure Training

Habituation and sensitization exert significant influences on the expression of fearful behavior (see *Habituation and Sensitization* in Volume 1, Chapter 6). Under ordinary circumstances, habituation and sensitization interact to adjust reflexive emotional behavior adaptively to environmental stimulation. Although mild fears can be attenuated by repeated exposure to a fear-eliciting stimulus or situation, pathological fears and phobias may resist habituation efforts or worsen as the result of repeated exposure. Habituation occurs when some response is repeatedly elicited—nothing more is needed than repeated stimulation. During habituation, the threshold, magnitude, and latency of the elicited response are gradually altered. For example, dogs fearful of traffic sounds may slowly learn to ignore such noises if given measured and systematic exposure to such stimulation. If, however, a dog, which has been fully habituated to traffic sounds, is frightened by a startling event, such as an accident or nearby exhaust backfire, the

previously habituated fear response may reappear or be dishabituated as the result of sensitization. Following the sensitizing event, the dog may become more reactive to traffic sounds than before and respond aversively to sounds that it had previously ignored.

Although habituation results in relatively stable changes in behavior or potential, the habituated response is subject to the influence of spontaneous recovery. Spontaneous recovery occurs when the eliciting stimulus is discontinued and presented again after some test period, at which point the habituated response may rapidly recover strength. In addition, habituation is highly sensitive to contextual influences and various concurrent stimuli that may serve either to facilitate or to impede habituation (Leibrecht and Askew, 1980). Repeated presentation of weak stimuli results in more rapid habituation than strong startling ones. For example, fearful responses to loud thunder may persist despite repeated exposure to the sound of thunder and may actually increase in magnitude with repeated exposure. Instead of habituating to the thunder stimulus, dogs fearful of thunder may become progressively reactive to it. If the sound of thunder is presented in a weaker form (e.g., a low-volume recording) the dog may rapidly habituate to the sound, but if exposed to loud thunder it will immediately dishabituate and exhibit the previously habituated fear response. Desensitization by habituation involves exposing dogs to graduated fear-eliciting stimuli without the presence of a counterconditioning stimulus, a process that can be rendered more effective by introducing various training and play activities at every stage to enhance confident interaction with the feared situation.

Habituation is an important aspect of puppy training. The goal of habituation is to provide a puppy with guided experiences to familiarize it with common sources of stimulation that it will likely encounter as an adult. As the result of habituation, puppies learn to respond to such stimulation without becoming overly reactive or panicky, but perhaps more importantly such preexposure helps to prevent conditioned fears from forming as the result of subsequent aversive or fear-eliciting exposure. Early habituation and preventive-exposure training (PET) appear to help immunize dogs against fear conditioning when exposed to startling or threatening stimulation involving similar stimuli or circumstances in the future. The habituation process is basically a latent-learning process in which repeated exposure to some situation or stimulus without consequence retards or inhibits the ability of the stimulus to form conditioned associations with threatening events later on (see *Latent Inhibition* in Volume 1, Chapter 6). Latent inhibition can play a particularly useful role in the prevention of fears acquired as the result of associative learning (Lubow, 1998). Uneventful preexposure exerts a robust effect that can be easily integrated into puppy-rearing practices. For example, a fear of being inside a car can be prevented by allowing the puppy to explore it on several occasions before going on its first car ride. The first few rides should be brief and end in playful or uneventful activities. Repeated and uneventful visits to the veterinary clinic can help reduce the risk of the puppy developing conditioned fears when aversive procedures (e.g., injections) are performed. Also, repeatedly exposing the puppy to grooming tools (comb, brush, nail clipper, and so forth) before using them to perform grooming chores may produce valuable latent-inhibition effects, interfering with fearful learning occurring in association with actual grooming. PET is particularly useful in the case of noisy devices (e.g., dremel and electric shears), which may require graduated exposure and counterconditioning to prevent an unconditioned fear. Puppies exhibiting noise sensitivities, especially when belonging to a family line with a predisposition to thunder phobias, should be given PET and preventive graduated counterconditioning using storm and thunder tapes to help prepare them for their first exposure to such fear-evoking stimulation. Without the immunizing effects of PET, the first exposure to thunder and lightning may trigger an enduring sensitization and fear. Thunder phobias may be easier to prevent than cure once they are fully established. Perhaps in areas where thunderstorms are common PET should be performed as a routine procedure in conjunction with other puppy-training and socialization efforts.

Although habituation may help modulate fearful arousal and aversive conditioning, inappropriate exposure to aversive situations may result in sensitization and adverse socialization effects that dispose affected dogs to overreact to social and environmental stimulation in adulthood. In addition to habituation, socialization helps to adjust a puppy's emotional response to social encounters with people and other animals. Early experiences with varied social stimuli serve to modulate fearful arousal when a puppy makes contact with people and other dogs. Puppies deprived of adequate habituation and socialization may develop pronounced deficits in their ability to interact normally with the physical and social environment, including the development of debilitating fears as adult dogs. In addition to increased sensitivity to fear conditioning between weeks 8 to 10, later developmental periods (e.g., 4 to 5 months of age) may occasion an increased responsiveness to fear-eliciting and territorial stimuli (see Serpell and Jagoe, 1995).

Social Facilitation and Modeling

Dogs exhibit a wide variety of social signals and displays in an effort to influence the behavior of other dogs and people. These signals typically produce an emotional effect in the receiver, functioning as an establishing operation conducive to the desired behavioral change. In addition to affecting the emotional state of the recipient, the emotional state of the sender of signals is affected. For example, appeasement displays appear simultaneously to evoke emotions incompatible with overt attack in the receiver while stimulating emotions compatible with submission in the sender. Some signals appear to be exhibited with the intention of reducing aversive arousal without signifying appeasement (see *Cutoff Signals* in Volume 1, Chapter 10). These cutoff or "take it easy" signals promote compromise and serve to quiet fearful or aggressive arousal. Dogs also exhibit a variety of displays intended to increase social arousal and affection (e.g., greeting rituals and play solicitation). Not only do dogs behave in specific ways to alter the emotional arousal of others, they are also highly responsive to the emotional behavior of others. Contagious behavior and social facilitation are common among dogs. For example, in a kennel situation, if one dog begins to bark in response to a strange noise near its run, other dogs in a remote part of the kennel will also bark, even though they had not heard the noise themselves.

The ability of dogs to be affected by the emotional states of others offers a potentially useful means for modulating certain forms of fearful arousal. Unfortunately, however, contagious behavior exhibits a significant degree of biological preparedness, with some emotional states and activities being more contagious than others. For example, dogs living in the same household may respond to storm activity in distinctly different ways. One of the dogs may become extremely fearful with the approach of a storm, while another may simple curl up and ignore it. A third dog may become alarmed by the sound of thunder and bark but not show evidence of fear. These differential responses to the approaching storm reflect different coping styles—styles of behavior that appear to be highly resistant to local social influences and contagion. Similarly, two dogs living together may exhibit very pronounced differences with regard to their respective responses to separation. Whereas one of the dogs may exhibit intense separation distress, the other may simply lie down and wait for the owner's return. Interestingly, the separation-reactive dog is often oblivious to the presence of the nonreactive dog; similarly, the separation-relaxed dog is not likely to become reactive as the result of social facilitation or contagion.

The relative resistance of intense fear to modulation by incompatible social contagion makes procedures designed to aid fearful dogs with jocundity and jollity seem somewhat questionable with respect to efficacy and treatment value. The author's attempts to induce emotional playfulness in highly fearful dogs by laughing and so forth have not been successful. In the presence of intense conditioned or unconditioned fear,

dogs appear confused or simply ignore laughter and other contrived efforts at jollity, and any benefit is rapidly overshadowed by growing fear. Feigned jollity may be too weak as a counterconditioning stimulus to support the effective and sustained modulation of fearful arousal. Nevertheless, in the case of mild fears associated with the introduction of new things or places or intense fears that have been reduced by other means, vocal jocundity and encouragement, together with various play activities, appear to provide useful diversions to help reduce fear (see *Play and Fear* in Volume 1, Chapter 3). For example, play can effectively promote familiarity and improved competency toward some feared activities (e.g., training dogs to swim or jump). Also, despite the aforementioned concerns regarding the efficacy of jollity as a counterconditioning stimulus, some fears may be modulated by presenting the dog with a prized toy or ball or by engaging the fearful dog in some activity that generally evokes excitement incompatible with fear, as indicated by the presence of tail wagging (Campbell, 1992). Perhaps better effects than obtained by feigned jollity may be attained by mimicking canine play signals, including play postures and sounds. Simonet and colleagues (2001) have reported that recordings of play-soliciting vocalizations (rapid huffing sounds) appear to increase the readiness of young dogs to play (see *Play and Leadership* in Chapter 6). Finally, although laughing and humoring fearful dogs may not significantly or reliably compete with fearful arousal, such vocalizing activities may help owners of such dogs to feel better by reducing their own anxiety, making such techniques useful placebos if not efficacious treatment modalities, especially in the case of owners showing high anxiety levels in response to the dog's fearful behavior. Reducing owner anxiety levels is not insignificant, since the owner's emotional state appears to affect how he or she copes with the dog's fearful behavior. Anxious owners appear to view their dogs' anxiety as more troubling or disturbing than do nonanxious owners (O'Farrell, 1997).

Some pathological fears and generalized anxiety disorders may respond beneficially to social facilitation and modeling. For example, McBryde and Murphree (1974) observed that social facilitation and modeling aided nervous pointers to become good hunting dogs. While hunting in the company of normal pointers, human-avoidant pointers became much more tolerant of human contact. Unfortunately, the beneficial effect did not endure after the dogs were returned to the laboratory. Similarly, Baum (1969) reported that the efficacy of response prevention for extinguishing fearful behavior in rats is greatly enhanced by the presence of nearby nonfearful rats. In the case of dogs living together in groups, socially fearful dogs appear to be emotionally supported by the activity of more confident dogs. Dogs that would otherwise avoid people are often much more willing to make such contact if in the presence of a people-friendly canine companion. This evidence suggests that the extinction of certain fears (especially those involving fear of people), counterconditioning, and the acquisition of prosocial behavior may be facilitated by the use of a more confident dog to model the desired behavior. In fact, dogs that are socially confident and outgoing can be very helpful as therapy assistants. The more outgoing dog provides a model of successful social behavior for the more socially inhibited one. For example, doling out treats to a confident canine cotherapist for approaching and staying near the trainer may help to lure an avoidant dog into closer proximity to obtain a share of the easy food. Seeing another dog eat may increase appetite in the fearful dog sufficient to overshadow or restrain its fear momentarily, thereby enabling it to make progressively closer and more relaxed contact with people. The model/rival procedure may possess value for momentarily altering mood or mediating rapid, but temporary, adjustments that may be subsequently strengthened and made more durable by reward training. Preliminary experiments appear to indicate that the model/rival procedure produces rapid changes in social and object-oriented behavior, perhaps having applications in the control and management of certain social and object-related fears (see *Complex Social Behavior and Model/Rival Learning* in Chapter 10).

Coping with Fear and Stress: Licking and Yawning

Voith and Borchelt (1996) have observed that licking and yawning often occur in situations involving conflict and stress. Dogs that are uneasy or fearful of approach often exhibit licking and lick-intention movements. They have also observed that yawning appears to occur in conflict situations involving a delay of gratification or frustration (e.g., waiting to be let outdoors). Licking activity may become an exaggerated or compulsive self-directed behavior, sometimes resulting in lesions to the legs (see *Licking, Sucking, and Kneading* in Volume 1, Chapter 5). They report that when a dog is restrained and exposed to an uneventful social situation in which it feels uneasy or fearful, it may involuntarily doze while sitting, standing, or lying down (sternal recumbency). Such dogs appear to fight an urge to doze that develops over time in the situation, finally losing muscle tone and slipping briefly into sleep, whereupon they start and awaken to continue the vigil. Such dogs appear conflicted between a need to maintain alertness and an opposing urge to fall asleep.

Yawning is common in similar situations of declining attention requiring an increased level of arousal and alertness. Dogs may yawn when forced to practice repetitive and monotonous training exercises, such as repeated sit-stay behaviors. In some of these dogs, yawning appears to present with penile erections, but it is not clear whether the erections are causally linked with the act of yawning or simply part of a coping response to such situations. Whether such dogs are stressed, bored, drowsy, or all three is debatable, but trainers can avoid such tedium by keeping their training sessions brief, reward dense, and playful. Yawning probably performs a cognitive-enhancement function by boosting ebbing attention under conditions in which the dog must continue to wait or defer. Similarly, yawning may help to mediate adjustments in response to unsettling social situations requiring that the dog maintain alertness while at the same time remaining inconspicuous and inactive. Yawning may also occur under certain fear-eliciting social situations. For example, Beerda and colleagues (1998) reported that yawning and stress-related oral activities (e.g., licking movements) occurred in association with fear produced by restraint or startle, but only if a person was present. These findings suggest that at least some stress-related yawning and licking may be expressed with a social intent (appeasement signal) that might not occur (or occur less frequently) in the absence of an appropriate social object. In addition, licking may perform a displacement or cut-off function, perhaps used to appease or pacify the approaching person or dog (see *Cut-off Signals* in Volume 1, Chapter 10). A pacifying function has been attributed to canine yawning, including a host of other sociosexual communication functions (Abrantes, 1997) and a controversial calming or reassuring effect that is purportedly induced when an owner yawns at a distressed dog (Rugass, 1997).

In humans, yawning is partially involuntary, socially contagious, and appears to increase alertness and arousal (Baenninger et al., 1996). Once yawning begins, it is often repeated and may facilitate yawning by others nearby, suggesting the possibility that it exerts a remote contagion effect via observation; however, merely thinking about yawning can also evoke the response. Although an increase in oxygen/carbon-dioxide exchange in the lungs has been proposed, the actual physiological function of yawning has not yet been determined. Yawning is phylogenetically ancient and is under the control of a variety of neurotransmitter systems and interactions, including stress-sensitive acetylcholine and dopamine pathways. Circulating glucocorticoids and other neuropeptides (e.g., ACTH and prolactin) exert a facilitative effect on yawning consistent with a stress-related function. Dopamine (D) appears to play a prominent role in the stress-related evocation of yawning via the release of oxytocin at the level of the paraventricular nucleus of the hypothalamus (see *Startle and Fear Circuits*), which subsequently activates an oxytocinergic pathway projecting to the hippocampus (Argiolas and Melis, 1998)—a potentially significant link-

age mediating the social contagion effects of yawning.

The multifaceted role of central oxytocin in the expression of sexual behavior (perhaps explaining the occurrence of stress-related penile erections), social recognition, attachment and bonding, and the diminution of irritability and aggression (Panksepp, 1998), suggests that yawning may help to modulate aversive emotional arousal produced in association with stressful social interaction (see *Neuropeptides and Social Behavior* in Chapter 4). Among olive baboons, anxious yawning and other self-directed behaviors (e.g., touching, scratching, grooming, and shaking) increase approximately 40% if the closest group member (within 5 meters) is dominant, which suggests that such anxious behavior may sometimes possess a social significance (Castles et al., 1999). Yawning may increase attention in social transitions requiring inactivity and deference, while at the same time helping to reduce social anxiety and aggressive arousal by producing incompatible cognitive and emotional changes via the release of oxytocin (e.g., enhanced social recognition) and other neural changes conducive to peaceful social transactions. Dogs can be trained to yawn by means of instrumental techniques (Konorski, 1967), which suggests the possibility that the response might be influenced by learning and used in some instances as a deliberate signal to indicate a readiness for increased activity, waning patience, or other information. Many dogs exhibit yawns that include drawn-out high-pitched squeaking or abbreviated high-pitched howl–like sounds that conclude with chomping or clacking sounds with a sigh of apparent exasperation. Such variations in canine yawning may be produced with a signaling intent, depending on the situational and motivational context in which they occur. Audible squeaks, chomps or clacks, and sighs may be used to draw the owner's attention to the yawn and to help clarify its significance, perhaps resulting in its periodic reinforcement.

Licking and lick-intention movements serve a significant canine social communication function when performed in the context of appeasement and care-seeking situations, but it is not clear whether licking actions performed by a person toward a fearful or stressed dog serve to produce a calming or reassuring effect or any effect at all. In the case of yawning, given its complex neurobiological nature and close association with the central release of oxytocin, one might best keep an open mind with regard to its potential value as a social signal and capacity for inducing a calming or pacifying effect. Casual experiments by the author to test the calming-signal hypothesis (i.e., the belief that yawning or licking might produce a calming effect in dogs) were without consistent effect, but some dogs do respond to human licking by licking back in return, by averting their gaze or head, by backing away, or by yawning in response to repeated licking actions, which raises the possibility that such signals might actually produce a mildly aversive effect in recipient dogs. Further, merely attracting the dog's attention repeatedly (Grahm et al., 1966) or petting it (Kostarczyk and Fonberg, 1982; Hennessy et al., 1998) may produce a calming effect of variable strength. As a result, some caution should be exercised in suggesting that such signals have special calming properties, particularly when used arbitrarily and out of context.

COUNTERCONDITIONING

Dogs experiencing fear may be functionally incapable of responding in an organized and purposive way to threatening situations. Extreme fear impedes purposive action, paralyzing the animal when it most needs to act effectively and decisively. Until the debilitating fear affecting these dogs is reduced to manageable levels, they will continue to react impulsively rather than learn how to cope in a more measured and adaptive way. The level of fear in such cases is not simply the result of some triggering event, but also reflects a dog's relative confidence and ability to exercise appropriate instrumental control over the threatening situation. To the extent that the dog is unable to control the situation, its fear may escalate into panic rendering behavioral efforts progressively disorganized and unadaptive. Under the influence of intense fear, and unable to respond in an organized way,

incompetent fearful dogs may cope by relying on primitive species-specific defensive reactions. Ultimately, the goal of behavior therapy is to improve a dog's behavioral coping skills when encountering aversive situations. However, the first step toward improved behavior is the initiation of efforts designed to reduce aversive arousal to a more manageable level (see *Counterconditioning* in Chapter 7).

Most common procedures used to control excessive fear in dogs involve some element of counterconditioning (Hothersall and Tuber, 1979; Voith and Borchelt, 1985; Shull-Selcer and Stagg, 1991). Graduated counterconditioning is performed by exposing the dog to a gradual progression of increasingly feared stimuli while simultaneously evoking emotional arousal incompatible with fear (see *Counterconditioning* in Volume 1, Chapter 6). Attractive and aversive stimuli exert mutually antagonistic behavioral, emotional, and physiological effects (see Dickinson and Pearce, 1977). An aversive stimulus can be gradually cross-associated with a hedonically opposite and incompatible emotional state by means of classical conditioning. In the presence of a fear-eliciting stimulus, relaxing or appetitive activities may inhibit or overshadow fearful arousal normally produced by the stimulus, allowing it to acquire attractive significance. Another way to conceive of counterconditioning is in terms of the reduction in escape and avoidance behavior. By repeatedly presenting the fear-eliciting stimulus while emotional responses incompatible with escape and avoidance are arranged to prevail and remain unperturbed by the aversive event (e.g., appetitive arousal), the previously feared stimulus may gradually become an associative signal for emotional responses incompatible with fear. Although counterconditioning may result in the development of new associations, the permanent uncoupling of the conditioned fear stimulus does not appear to occur as the result of the procedure.

As a result of counterconditioning, the aversive stimulus is classically cross-associated with reward incentives and pleasurable hedonic emotions that are antagonistic to fear. While fear elicits escape and avoidance, reward incentives stimulate approach, making counterconditioning prone to produce approach-avoidance conflict. Approach-avoidance conflict may be reduced by gradual exposure to a fear-evoking stimulus through small steps moving from least aversive to most aversive, until finally the dog can tolerate close contact with the feared stimulus or situation without experiencing disruptive fear. Under conditions of reduced fear, the dog can be encouraged to interact with the feared stimulus or situation more competently and confidently. The introduction of appropriate play-facilitated behavior and interactive skills is highly conducive at this point for the promotion of confident control expectancies and more natural social or exploratory modal behavior. Counterconditioning is likely to exert the most benefit in the case of fears resulting from socialization and habituation deficits or developing as the result of sensitization. Fear associated with conditioned escape and avoidance appears to be less sensitive to counterconditioning efforts.

Daily counterconditioning efforts should be recorded in a behavioral journal or chart (Figure 3.3). Methods such as interactive exposure with response prevention can be highly stressful for both dog and owner, and should be employed in combination with counterconditioning and positive-reinforcement techniques, perhaps helping to reduce adverse secondary stress and improving owner compliance. Finally, once a fear-evoking stimulus is reduced by exposure and counterconditioning, play therapy may be considered. Play is particularly useful for the acquisition of new prosocial behavior patterns or as a means to establish active interaction with a previously feared situation.

Fear Reduction and Approach-Avoidance Induction

Counterconditioning is used to alter an animal's fearfulness by associating the feared stimulus/situation with a motivationally antagonistic state. For example, dogs afraid of strangers can be encouraged to take food when people are nearby, thereby eliciting appetitive arousal incompatible with fear while in the presence of people. The attractive expectation of receiving food in the presence of nearby people motivationally competes

DOG'S NAME: DATE:

SESSION NO.:

COUNTERCONDITIONING RECORD

TRIAL	STIMULUS	DISTANCE	DURATION	DOG'S RESPONSE
1				
2				
3				
4				
5				
6				
7				

COMMENTS:

FIG. 3.3. Counterconditioning chart. The headings of the chart should be modified to accord with the trigger stimulus dimension being counterconditioned.

with fear otherwise triggered by their presence. After repeated trials, the approach of a stranger may gradually no longer just elicit fear, but instead cause the dog to eagerly anticipate the presentation of a tasty treat. Through gradual steps, the dog's fearful emotional arousal may be progressively offset with a new set of prediction expectancies, enabling the dog to interact less cautiously with strangers. Although such modifications and cross-associations may help to reduce certain aspects of the dog's response to the feared

stimulus and establish new positive associations, especially in the case of fears resulting from a lack of familiarity (habituation deficit) or as the result of sensitization, counterconditioning appears to be significantly less effective in the case of conditioned fears operating under the control of expectancies that have not been disconfirmed. Although counterconditioning may establish new associations that compete with the emotional responses elicited by the feared stimulus, it may not alter the subcortical fear memory. In effect, rather than resolving the conditioned fear, counterconditioning may result in establishing an approach-avoidance conflict toward the conditioned feared stimulus (see *Partial-extinction Effects, Response Prevention, and Behavioral Blocking*)—an effect that can be particularly problematic in the treatment of dogs presenting with aggression problems associated with fear and avoidance.

In addition to the use of graduated counterconditioning and other progressive exposure techniques, instrumental avoidance behavior may need to be blocked by appropriate means (Askew, 1996). This strategy is often necessary to convince a dog that its reactive avoidance behavior is unnecessary. Consequently, response prevention is a very important aspect of fear management and modification, since allowing a fearful dog to engage in escape/avoidance behavior during graduated exposure may result in an increase of fearful behavior rather than helping to decrease it. Dogs exhibit avoidance behavior to control fear-provoking situations, and since a dog is likely to achieve some degree of success and relief from such efforts, the behavior is likely to undergo reinforcement, that is, confirm the operative control expectancy. The potential for inadvertent reinforcement under such circumstances is significant. Escape and avoidance behavior prevents dogs from learning that the feared stimulus or situation is not really a threat. By gradually bringing a dog into a closer proximity with a feared situation, sometimes against its most vigorous resistance, it is able to learn that the stimulus or situation is harmless and, further, that such contact is actually associated with pleasant things. On the other hand, letting the dog bolt out of "harms" way is contrary to constructive training and counterconditioning efforts. Of course, it is important that a fearful dog be gradually desensitized to the trigger stimulus with an appropriate combination of fear-reducing techniques (e.g., habituation, counterconditioning, and stimulus change).

Critical Evaluations of Counterconditioning

Despite its widespread use and apparent efficacy in the treatment of human fear and phobias (Bellack and Hersen, 1977), over the years since Wolpe's discovery of systematic desensitization (Wolpe, 1958), scientific debate has questioned its efficacy for treating phobias. In particular, the need for antagonistic arousal and carefully constructed fear hierarchies has come under question and criticism (Marks, 1987). Neither the ranking of feared samples nor the presence of a relaxing/appetitive counterconditioning stimulus have proven especially significant with respect to the overall reduction of fear and anxiety, either in laboratory animals or in human patients exhibiting fearful behavior. Marks (1978a and b), who carried out an exhaustive survey of the relevant experimental and clinical literature, came to the following conclusion:

> Arousal level during exposure does not seem crucial for improvement, which proceeds at a similar rate whether patients are relaxed, neutral, or anxious during exposure. Controlled work shows both relaxation and deliberate anxiety evocation to be redundant, time-wasting, and unnecessary for the treatment of phobias and obsessions. Systematic reward has not been found especially helpful, though it assists motivation. … Exposure appears to be especially effective when it is interactional, with the patient actively approaching and grappling with the ES [evoking stimulus] in some way. (1978b:236)

He noted that working up the hierarchy of increasing fear arousal was just about as effective as working down in terms of final results.

Similar observations and concerns about the efficacy of graduated counterconditioning have been reported involving laboratory-animal subjects. For example, Delprato (1973) found that extinction following full

exposure to a fear-eliciting conditioned stimulus (fear-CS) outperformed both graded exposure and graded counterconditioning. In the protocol used in his experiments, counterconditioning with food actually impeded the extinction of fear. These findings suggest that food may serve only to divert an animal's attention away momentarily from a feared stimulus without significantly altering its fear. Further, the resultant distraction may cause animals to miss the significance of the conditioned stimulus, thereby shielding it from extinction. The failure of counterconditioning with food to reduce fear became apparent when the fear-CS was presented in the absence of food:

> Rather than facilitating elimination of avoidance, explicit pairing of the anxiety/avoidance competing response of eating with graded exposure to the aversive stimulus was equivalent to control treatment [no exposure to the aversive CS] and, relative to graded and nongraded exposure only, actually impeded elimination of the response. (53)

Delprato suggests that the effectiveness of graduated counterconditioning may be improved by presenting the fear-CS first and allowing the animal to recognize it fully as such before presenting food and other counterconditioning stimuli.

Lastly, upon reviewing a wide array of animal (and human) studies investigating fear-reducing techniques, Thyer and colleagues (1988) concluded that, although useful, counterconditioning appeared to be the least efficacious means for reducing fearful behavior. The most effective techniques, in order of decreasing value, were response prevention, response prevention with distraction, response prevention with noncontingent reward, and response prevention with contingent positive reinforcement (shaping). Despite some of the apparent procedural and efficacy problems with counterconditioning, the authors emphasized that both counterconditioning and positive reinforcement of behavior incompatible with avoidance have a useful place in the armamentarium of a comprehensive fear-therapy program. Oddly, given the rather problematic issues surrounding counterconditioning and the refractory nature of many fears (especially those associated with generalized anxiety and loud noises), it is rather astonishing that one author claims in a scientific journal to have a achieved a 100% success rate involving 89 fearful dogs by using a program of counterconditioning without drugs (Rogerson, 1997). Unfortunately, the study does not contain analyzable data or experimental controls with which to assess the validity of these dramatic and unexpected findings.

PLAY AND COUNTERCONDITIONING

The emotional excitement and joy produced by play are incompatible with fear, making play extremely useful for the treatment of mild to moderate social fears. If play can be produced in the presence of a fear-provoking stimulus, several potential benefits may be obtained. For one thing, play enhances a dog's confidence and willingness to take risks. Instead of the wariness, anxious vigilance, and inhibition associated with fear, play mediates a more curious, experimental, and spontaneous attitude toward the environment. Playful dogs are more free and able to behave in spontaneous ways, just because they are not overly preoccupied with the potential consequences of their behavior. Under the influence of play, fearful dogs may be more able to interact with the environment flexibly, thereby allowing them to learn and integrate new control modules, routines, and patterns under the active modal influence of play (see *Training and Play* in Chapter 1).

Trumler (1973) succinctly and correctly observed, "The dog learns by playing" (124). Playing is no less important in the case of normal skill learning than it is in the unlearning of fears. Activities associated with play and curiosity are unique in that they appear to be intrinsically reinforcing and apparently done for their own sake. The consummation of play appears to educe joy and immediate gratification. Play occurs without any apparent interest or concern for advantages in the future; the only goal of play is the perpetuation of play and the joy it produces. Play is a source of continuous reward for dogs, and behaviors used and integrated into play tend to become

progressively stable and reliable. While playing, dogs can safely practice and learn numerous social skills. Both play and curiosity appear to operate on a high level of cortical organization, driving a highly flexible and experimental attitude and behavioral interface with the environment, precisely the sort of thing that is needed by fearful and aggressive dogs to overcome their biased perceptions.

Not unexpectedly, fearful dogs are usually very inhibited and reticent to play while in the presence of the feared stimulus. This play inhibition is in sharp contrast to the animation that they may ordinarily exhibit when alone with owners in the safety of familiar surroundings. Fearful dogs are unable to respond to play invitations, not so much because they are unable to play, but simply because they do not *feel free* to play; that is, they are inhibited by fear. Encouraging dogs to play in a variety of situations with both familiar and unfamiliar partners helps to promote a more generalized prosocial attitude, gradually causing the dogs to view people less suspiciously—perhaps eventually causing the dogs to view people as potential playmates. Similarly, play can help to restrain arousal associated with environmental sources of fear such as loud noises; for example, Hothersall and Tuber (1979) reported that the noise-phobic Labrador retriever "Major" could better tolerate evoking stimulation if engaged in ball play (see *Major: A Thunder-phobic Dog* in Volume 2, Chapter 3).

Several dynamics govern play behavior, making it a fitting tool for this purpose. Play is influenced by a safe-expectancy bias and can be helpful to facilitate socially risky behavior in dogs. Such features of the activity are obviously very desirable in the context of interactive exposure. The safe expectancy associated with play is the outcome of natural or species-typical boundaries and rules regulating such contact and activity, permitting interaction that might be perceived as threatening under other circumstances. As a result, play allows individuals to become more intimately familiar with one another, it promotes affectionate bonding, and it helps to establish social stratification without the risk of inciting serious combative contests. In short, play facilitates the development of a friendly and joyful relationship (see *Fair Play, Emergent Social Codes, and Cynopraxis* in Chapter 10).

Instrumental Control and Fear

There is some inconsistent usage of the term *counterconditioning* in the applied and veterinary behavior literature. Counterconditioning, a classical conditioning procedure, is often used to describe instrumental training efforts in which an incompatible response to fear is prompted and positively reinforced. This mixed usage is somewhat problematic and should be avoided. Instrumental control efforts typically involve obedience commands (e.g., "Sit"), prompts, and consequences that may or may not provide secondary counterconditioning benefits. Separating fearful behavior into instrumental and classical fractions is somewhat arbitrary, but the division is useful in this case since not all instrumental control efforts necessarily exert a counterconditioning effect (e.g., behavioral blocking), at least not initially. In combination with response prevention and graded counterconditioning efforts, fearful dogs are often trained to perform various obedience modules and routines incompatible with escape and avoidance. Usually, dogs undergoing counterconditioning are given intensive preliminary training to enhance attention control and to perform a variety of basic exercises (e.g., a rapid and reliable sit and down response, indoor and backyard recall, starting exercise, controlled-leash walking, and a reliable sit- and down-stay lasting for at least a full minute under distracting circumstances). When exposed to the fear-provoking situation, these various instrumental behaviors are prompted through commands and various other signals to bring the dog into closer interactive proximity with the feared situation. The social and tangible positive reinforcers used to support exposure and interaction with the evoking stimulus may perform a significant counterconditioning function. Conditioned reinforcers appear to play an important role in this regard (see *Classical Conditioning, Prediction, and Reward* in Chapter 1). When properly conditioned, bridging signals acquire potent alerting and

orienting features that can be used to shape behavior incompatible with fear while at the same time eliciting antagonistic emotional arousal associated with reward. Brief and crisp vocal and mechanical sounds appear to be more effective as conditioned reinforcers than drawn-out vocal phrases. Maximal arousal of conditioned reward effects occurs with the onset of the conditioned reinforcer rather than its offset. A highly conditioned bridge can be used to introduce powerful positive prediction error and dissonance effects.

Stimulus Dimensions Influencing Fearful Arousal

The desensitization hierarchy is constructed by organizing the presentation of fear-provoking stimuli and situations along a continuum of increasing fearfulness. Several overlapping dimensions are involved, each of which should be given careful consideration when devising a hierarchy of graded exposure and desensitization. They include proximity, context, similarity, intensity (quantity), contrast (quality), duration, frequency, predictability, controllability, and stimulus continuity (Table 3.1). Desensitization can occur by counterconditioning (requiring the elicitation of incompatible emotional arousal) or habituation (repeated presentation of graduated samples of the fear-eliciting stimulus). Desensitization by habituation does not depend on the presence of a counterconditioning stimulus.

Counterconditioning Stimuli

When desensitizing fearful reactions by counterconditioning, a list of counterconditioning stimuli should be identified. A counterconditioning stimulus must be both incompatible with the feared stimulus and sufficiently strong to compete with its fear-eliciting properties (Figure 3.4). Counterconditioning stimuli usually have a calming, appetitive, or pleasurable effect on dogs. The most commonly used counterconditioning stimulus is food. A dog's relative interest in food is a sensitive measure of its emotional state, with anxious, fearful, or aggressive dogs often refusing food offered to them. Appetite and fear appear to inhibit each other reciprocally. Seeding the situation with treats that the dog can search for and easily find appears to work better as a counterconditioning stimulus than simply feeding it by hand as it stands or sits in the presence of the fear-eliciting stimulus. Searching activity appears to help restrain fearful behavior. Also, highly motivating appetitive stimuli varied in size and type will produce a stronger effect than giving the dog a food item of low reward value and novelty (e.g., kibble). Feeding the dog a highly appetizing meal in the presence of a graduated fearful stimulus can be an effective means to reduce fear reactivity, especially if it is done over several days or weeks.

Appetitive arousal and fear typically exert a pronounced antagonistic influence over each other in dogs, perhaps stemming from a close evolutionary affinity and organization at the level of the hypothalamus controlling approach and avoidance behaviors. Counterconditioning with food probably exerts an influence at the level of the ANS, wherein food-induced parasympathetic arousal works to avert or restrain fear-related sympathetic arousal (see *Hypothalamus* in Volume 1, Chapter 3). Appetite and fear are motivationally antagonistic to each other or, as has Wolpe says, they *reciprocally inhibit* each other: the arousal of one motivational system inhibits the arousal of the other (see *Reciprocal Inhibition* in Volume 1, Chapter 6). Although food is an extremely useful counterconditioning stimulus for moderating strong fears, it is of utmost importance that the dog's appetitive response be strong enough to overshadow its fear. If food is presented to an already fearful dog, the treat may become counterconditioned in an opposite direction; that is, food may become associated with fear—a highly undesirable and common outcome. The danger of inadvertent aversive counterconditioning is minimized by gradually exposing a hungry dog to minimally evocative samples of the fear-eliciting stimulus. It is also useful to vary the kind and amount of the food given to the dog at each step: surprise is a critical factor in using food as an effective counterconditioning stimulus.

Motor activity can also produce a mild counterconditioning effect by a process that Baum (1970) has referred to as *mechanical facilitation*. The critical issue is to maintain forward locomotion without evoking a freez-

Table 3.1. Stimulus dimensions affecting counterconditioning and desensitization efforts

Proximity: Most dogs tolerate the presence of a feared object, event, or person at a distance, but become progressively more fearful and reactive as fear-eliciting stimulus comes into close proximity (Figure 3.4). For instance, a distant roll of thunder may not have any discernible affect on thunder-phobic dogs until it reaches some critical proximity.

Context: Another important factor determining the fear-eliciting stimulus's relative strength is the influence of context. Exposure to a thunderstorm while the owner is nearby may be much less aversive for a dog than exposures occurring when it is alone. In addition to social variables, the environment itself may physiologically predispose a dog to fear (see Kallet et al., 1997).

Similarity: Besides proximity and context, dogs react differentially to the relative similarity between a presented stimulus and an actual feared object or event. Dogs unable to tolerate thunder may be able to accept other loud noises sharing some similar features with thunder (e.g., loudness and surprise). Such similar surrogate items may be selected in cases where the actual feared object or event is not readily available or easily tolerated.

Intensity: Fearful stimuli of low intensity are less provocative and more easily endured or habituated than more intense samples of the same stimulus. Recorded thunder effects played back at a very low volume are obviously much less frightening to a dog than when they are presented at full volume.

Duration: The duration of the fear-eliciting stimulus has a direct and significant bearing on the desensitization process. A dog is exposed to progressively realistic exposures as its tolerance will allow, but initially brief exposure to low-intensity stimuli helps to facilitate the process.

Frequency: Many fears are associated with extremely brief stimuli occurring within a fraction of second (e.g., gunfire), requiring that they be presented repeatedly. The frequency of presentation depends on a dog's response and recovery. Repeated exposure at low intensity appears to facilitate desensitization effects.

Predictability: Aversive stimulation occurring on a predictable basis is less fear arousing than when it occurs on an unpredictable basis. Anxiety can be interpreted as a state of vigilant arousal that occurs in response to a fear-eliciting stimulus that presents unexpectedly. Anxiety serves to lower fear thresholds, thereby competing with desensitization efforts. The infrequent, brief, and unpredictable occurrence of thunderstorms may significantly contribute to the development of storm fears via anxiety occurring during times of the year when storms are more common.

Controllability: Aversive stimuli and situations presenting with a high degree of controllability are far less provocative of fear and stress than are aversive stimuli that occur on a uncontrollable basis. Many fears reflect an underlying loss of confidence stemming from a lack of appropriate experience and skill or a history of failure with respect to the control of potentially dangerous situations.

Continuity: To be maximally effective, the desensitization hierarchy should have an even flow or continuity from lower items to higher ones. Sudden discontinuous jumps between items should be avoided.

ing or fleeing response. Making a dog move in a beeline toward a feared situation may rapidly overshadow the relaxing effects of motor activity with fear. It is often useful to approach the fear-eliciting situation on a slight curve, moving steadily away from the situation. Repeated passes may gradually result in closer and closer passes, evidencing fear reduction and decreased avoidance. While some benefit can be obtained by merely walking a dog near a fear-provoking situation, stronger effects are attained by periodic changes of pace (excited running), letting the dog find planted treats and engaging it in various play activities (e.g., tug games) while in the proximity of the feared situation. Mild fear can be modulated in some dogs by giving them a soft toy to carry. Toys stuffed with food can also be useful, especially if they are strategically hidden in a way that requires the dog to become progressively closer to the feared situation in order to find them. Prompting the dog to perform a series of well-conditioned obedience exercises and providing food and affection as rewards can be an extremely beneficial fear-

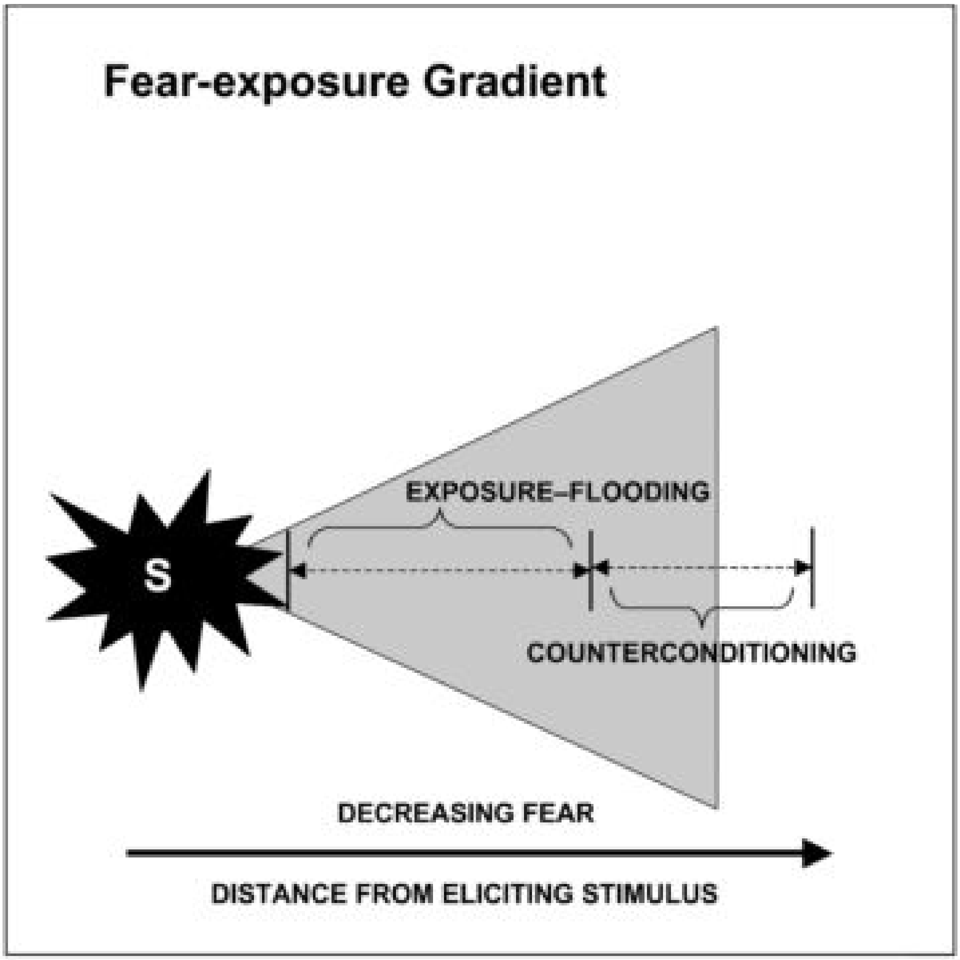

FIG. 3.4. Various stimulus dimensions, including distance, alter the capacity of a trigger stimulus to elicit fear. Effective counterconditioning is usually performed by evoking a state of arousal antagonistic to fear while exposing the dog to a minimally provocative fear-eliciting stimulus, whereas exposure with response prevention may be performed in the presence of more provocative trigger stimuli.

reducing technique, especially if a highly desirable reward is given for every correct response. Another powerful technique for modulating fear is structured postural manipulation together with relaxing massage and olfactory conditioning (see *Posture-facilitated Relaxation Training* in Appendix C), which appears to help restrain adverse emotional arousal and stress-related concomitants associated with fear. Finally, as previously noted, the presence of a confident canine cotherapist acting as a model for the desired behavior may facilitate the process through social facilitation and local enhancement (see *Social Learning* in Volume 1, Chapter 7). Model/rival play activity in which the dog is put on a tie-out and allowed to watch the trainer and owner tossing a ball back and forth and playfully interacting may inspire some dogs to lower their guard, especially in the case of highly sociable dogs showing a keen interest in the ball.

GRADED EXPOSURE AND RESPONSE PREVENTION

Although graduated counterconditioning may not be consistently effective in all cases and

may not be very efficacious as a stand-alone procedure for resolving conditioned fears, it does appear to provide benefit in many cases involving fear due to habituation deficits or adverse sensitization and remains a legitimate and useful tool for modulating fearful arousal in the context of behavior therapy, especially when used in combination with other behavioral procedures (e.g., graded interactive exposure, habituation, response prevention, attention therapy, and basic training). Perhaps the most important function of counterconditioning in the process of treating conditioned fears is to help modulate aversive arousal occurring in association with the graduated introduction of response prevention and to decrease anxiety associated with its fading and discontinuation.

Partial-extinction Effects, Response Prevention, and Behavioral Blocking

Conditioned fear is most effectively extinguished by disconfirming escape/avoidance expectancies (see *A Cognitive Theory of Avoidance Learning* in Volume 1, Chapter 8). In practice, fear is reduced under circumstances in which the escape/avoidance response is blocked, while the feared outcome is prevented and stimulation incompatible with fearful arousal is presented. Such treatment results in a condition of safety and fear reduction, but it may impede the full extinction of fear. Full extinction extends the partial-extinction effects obtained under the blocked condition to more natural unblocked conditions, thereby fully disconfirming the operative avoidance contingency. According to this interpretation, full extinction requires exposure to both blocked and unblocked conditions (see *Conditioned Fear and Extinction* in Volume 2, Chapter 3). As the result of response prevention, only the blocked condition is disconfirmed, leaving the unblocked condition untested; that is, the feared event might still occur when the blocking contingency is lifted. As such, the discontinuation of response prevention may generate significant apprehension and anxiety in response to the conditioned fear stimulus. Consequently, although response prevention may significantly reduce fear, apprehension and anxiety may occur when the safety of the blocking contingency is removed. By slowly fading the blocking contingency in association with counterconditioning, the risk of such anxiety can be significantly reduced; in turn, graded interactive exposure with response prevention can help to reduce the approach-avoidance conflict associated with stand-alone counterconditioning. The reciprocal benefits resulting from the combined use of response prevention and counterconditioning (RP-CC) strongly recommend that they be used together as complementary therapies in a comprehensive approach to the treatment of canine fears and phobias. In addition to disconfirming fearful expectancies, intensive basic training is seamlessly integrated into RP-CC procedures, with the goal of enhancing executive control functions (attention and impulse control) and improving the dog's ability to cope more competently with feared situations.

Response prevention is essentially a punitive contingency serving to disconfirm a dysfunctional control expectancy. In addition to physical restraint, avoidance control and safety training techniques might be considered in some cases to block escape/avoidance behavior and to reinforce incompatible behavior. A major potential advantage of such training is the internal relief/relaxation effects and safety associated with successful escape and avoidance (see *Safety Signal Hypothesis* in Volume 1, Chapter 8). Persistent and refractory fears stemming from sensitization or precognitive exposure to traumatic stressors may be responsive to an approach combining RP-CC and behavioral blocking. As the result of behavioral blocking via trained avoidance responses, fears operating independently of functional prediction-control expectancies might be brought under better functional executive control, thereby helping to mediate fear extinction via the formation of cortical inhibitory restraint over subcortical emotional fear memories. In addition to potential for restraining emotional fear, such training might help to reduce fearful behavior by consolidating fear-incompatible expectancies and emotional establishing operations in the presence of the fear-eliciting stimulus, thereby helping to modulate and normalize the dog's response to it. Behavioral blocking and avoidance training may produce significant

relief/relaxation, gradually causing the dog to feel safer in the presence of the previously feared stimulus or situation.

The current experimental literature indicates that graded interactive exposure and response prevention are the most efficacious means for reducing conditioned fear in animals (see *Interactive Exposure and Flooding* in Volume 1, Chapter 6). As the result of repeated safe exposures to the fear-provoking stimulus or situation (desensitization by habituation), the animal gradually learns that the feared situation is no longer predictive of aversive stimulation. Exposure works by extinguishing or habituating the fearful reaction, thereby disconfirming a dog's fearful expectancies and promoting a more adequately predictive and "reality tested" reaction to the evoking situation. When escape and avoidance efforts are blocked, many dogs eventually recognize that a threat no longer exists in the presence of the fear-evoking situation, a recognition that appears to produce relief and relaxation. Relief and relaxation following the cessation of aversive arousal provide a powerful counterconditioning influence (see *Response Prevention, Opponent Processing, and Relaxation* in Volume 2, Chapter 3). During graded interactive exposure, the dog is brought into closer and more varied contact and interaction with the evoking stimulus, thereby developing the confidence and skills needed to cope competently with the feared situation.

Graded Interactive Exposure

Graded interactive exposure is often combined with instrumental procedures in which trained behaviors incompatible with escape or avoidance are prompted and reinforced in the presence of a fear-provoking stimulus or situation. Preliminary attention and basic training consist of bridge conditioning, following and coming, orienting, sit- and down-stay, targeting, attending behavior, starting exercise, and controlled walking. The dog should be thoroughly desensitized to the fixed-action halter and kept on a hip-hitch and control lead or closed-loop system for added safety (see *Halter Collars* in Chapter 1), especially if manipulations tying up the hands are involved (e.g., using a squeaker, clicker, or food). In addition to prompting and reinforcing previously established control modules and routines in the presence of the feared situation, spontaneous approach behavior can be selectively reinforced via a DRO or shaping schedule of differential reinforcement while escape/avoidance behaviors are blocked. The idea is to encourage more competent behavior through successive approximations and spontaneous initiatives occurring in the absence of escape or avoidance efforts. In addition to overt dynamic and interactive behavior, shaping efforts can also be applied to static postural behaviors associated with increased confidence (e.g., tail relaxed or wagging, ears forward and alert, standing upright, leaning forward, not leaning on trainer or objects, and steady frontal orientation). Such training efforts exert both instrumental and classical conditioning effects incompatible with fearful behavior. Effective shaping depends on a well-conditioned bridging stimulus (see *Shaping Through Successive Approximations* in Volume 1, Chapter 7). The bridging stimulus is conditioned by repeatedly pairing a distinct auditory stimulus (e.g., "Good" or click) with the presentation of food and other rewards (e.g., affectionate petting and play). Both a vocal stimulus and a clicker-bridging stimulus should be conditioned to a high degree in the context of orienting training and controlled walking in advance of therapeutic applications. After several pairings, the bridging stimulus can be used to link or *bridge* desirable behavior with a spatially separated and delayed reward while at the same time evoking affects incompatible with fear. A squeaker bulb (without squeaker valve) scented with an odor (e.g., orange or lavender) is held in the right hand and squeezed just before the hand is opened to deliver treats. The conditioned odor can be subsequently used to augment appetitive counterconditioning efforts. Preliminary training should strongly focus on augmenting orienting and attending responses via the manipulation of positive prediction error and dissonance effects, using the dog's name or an orienting stimulus (e.g., a squeaker or smooching sound). Capturing the dog's attention in a decisive and timely way (i.e., at the earliest sign or link in the rapid

chain of events leading to the avalanche of emotional and behavioral events associated with fear) serves to interrupt and deflect fearful behavior, while enabling the trainer to redirect it toward activities incompatible with fear (see *Target-arc Training*). Many dogs trained in such a way adopt a coping pattern in which the feared stimulus prompts them to look toward the owner for support rather than balking, fleeing, or becoming reactive (e.g., compulsive barking).

The efficacy of graded-exposure training is influenced by a number of procedural constraints. Although exposure procedures can be extremely effective, they may make things worse when improperly performed. For example, repeated, *brief* exposures to intense fear-eliciting stimuli may increase fear and make subsequent exposure efforts more difficult. Exposure to the provoking situation should continue until fear subsides or is replaced by relief and relaxation. Also, unexpected and intense occurrences of the fear-eliciting stimulus may cause increased sensitization and dishabituation. This adverse influence is especially problematic when it is coupled with repeated, brief exposures to the intense sample. Many common fears appear to persist because the dog does not remain in the presence of the provoking situation long enough to benefit from slowly emergent opponent relief and relaxations effects. When startled, the animal simply hides or runs away. Interestingly, the brevity of intense loud noises (e.g., gunshots, fireworks, or thunder) may be a major factor in the development of phobias related to loud-noise stimulation. For example, thunderstorms are seasonal, they are brief, and they may involve intense acoustical stimulation capable of eliciting pronounced fear in predisposed dogs, independently of other sources of unconditioned aversive stimulation. Thunder-phobic dogs repeatedly exposed to these brief and traumatic experiences with thunder and lightning may become progressively sensitive to them as well as other phenomena related to storm activity. The periodic and intense nature of such stimulation precludes normal habituation and strongly recommends early preventive exposure in the case of dogs and puppies exhibiting a low startle threshold to noise (see *Habituation, Sensitization, and Preventive-exposure Training*).

Normally, following intense startle and fearful arousal, opponent relief and relaxation predictably follow the discontinuation of aversive stimulation (see *Safety, Relief, and Relaxation* in Volume 1, Chapter 3). Relief and relaxation appear to help restrain fearful arousal and to promote homeostatic adaptation following the aversive event. Relief occurs immediately after the aversive stimulus is discontinued and continues for 15 to 20 seconds. Relaxation is a more sluggish opponent process and begins to appear only after approximately 2 1/2 minutes after the aversive stimulus is withdrawn. To take full advantage of these effects, techniques involving the discrete presentation of fear-provoking stimuli should be spaced to maximize relief and relaxation effects. In addition, safety signals should overlap both relief and relaxation phases of postaversive adaptation. By pairing vocal cues (e.g., "Relax"), acoustical stimuli (continuous tones or music), various scents, and tactile signals (petting) with relief and relaxation, these combined redundant stimuli may gradually become conditioned safety signals predicting the absence of aversive stimulation (see *Fear, Cognition, and Avoidance Learning* in Volume 1, Chapter 3). Conditioned safety signals may function as conditioned inhibitors of fearful arousal (Hawk and Riccio, 1977) as well as evoke therapeutically beneficial conditioned safety-relaxation effects (Denny, 1976). As a result, conditioned safety signals provide a convenient means for reducing fearful arousal and encouraging more secure behavior when a dog is faced with a fear-provoking situation.

Rehearsal

Fearful arousal resulting in frantic escape or panic behavior is detrimental to the exposure process. If such behavior succeeds, a dog's reactive escape behavior may be strongly reinforced, leading it to respond in a similar way when exposed to the fear-eliciting situation in the future. Avoidance and escape behavior is incompatible with maintaining a progressively closer proximity with the threatening situation—a requirement for successful fear reduction. However, observing the feared stimulus

or situation at a safe distance, though comfortable for the dog, may not alleviate its fearful avoidance or promote confident behavior when it is brought into closer contact with the feared situation. The fearful dog must be gradually and systematically exposed to fear-provoking situations to optimize the effects of graded interactive exposure. Since fearful arousal may be increased by repeated, brief, and uncontrolled exposures to threatening situation, it is advisable that casual exposure to the fear-eliciting stimulus or situation be minimized.

Before exposing the dog to the actual fear-provoking situation, each step in the process should be rehearsed under minimally provocative conditions. For example, if the dog is afraid of strangers when they first visit the home, the various events and activities associated with such visits can be practiced in advance. Behavioral rehearsals include such activities as ringing the doorbell, leashing the dog, calling the dog to heel, training the dog to hold a sit-stay, opening the door, and finally appropriately reinforcing the dog's behavior. Most dogs enjoy going for walks, and the opportunity for such activity is associated with keen interest and anticipatory activity. Ringing the doorbell or knocking on the door before getting the dog's leash and going for a walk can help to countercondition aversive associations evoked by the sound of the bell. Whenever possible, taking the fearful dog for a walk with unfamiliar visitors is an effective interactive exposure technique. Not only are walks enjoyable, they can last long enough to moderate fearful arousal and facilitate relatively close and sustained interactive contact between a socially avoidant dog and people. Moreover, taking the dog outdoors and away from the home to interact with the visitor obviates confounding territorial issues that may complicate the situation.

To perform these various activities, it is imperative that fearful dogs learn to walk on a controlled leash, to perform the quick-sit without hesitation, and to hold a reliable sit-stay and down-stay. Such preliminary training should be practiced in every situation where the dog might potentially encounter the fear-eliciting stimulus. Food is a convenient reward, as it can be readily used as a counterconditioning stimulus, as well. Once all the elements have been trained and rehearsed, the next step is to stage the actual event by using a situation that is minimally provocative. Besides representing a positive in vivo exposure to a minimally evocative situation, such staging is a useful way to iron out any unforeseen difficulties that might emerge during more natural exposures later.

Staging and Response Prevention

Response prevention brings a dog into close proximity with the fear-provoking situation, thereby evoking low to moderate levels of fear that slowly undergo habituation. An important function of response prevention is to block undesirable escape and avoidance behaviors. Uncontrolled avoidance and reactive escape efforts hinder a dog's ability to unlearn the toxic emotional expectancy, thus forestalling the development of a more moderate and adjusted response to such stimulation. As the result of repeated uneventful exposures, the dog may gradually discover that its fear is unfounded and begin to experiment with more prosocial or exploratory behavior. Significant evidence suggests that the motor components of fear are localized in the basal ganglia (species-typical routines) and the cerebellum (skilled motor coordination), whereas the emotional aspects of fear are elaborated in the amygdala (Mintz and Wang-Ninio, 2001). This research suggests that fearful emotions and fear-related behavior are acquired and maintained in different parts of the brain. As the motor skills needed for successful avoidance are acquired, a significant reduction in fear arousal occurs. Motor competency appears to have a pronounced modulatory effect on emotional fear localized in the amygdala; however, reactive escape/avoidance behavior that does not provide enhanced control over the fear-eliciting stimulus may actually intensify fear. Fear-related motor output may have pronounced secondary effects on fearful arousal, especially if the animal's escape/avoidance efforts are frantic and disorganized. Consequently, such reactive responses to fear should be prevented or blocked and replaced with more competent and adaptive alternatives.

During the staging of in vivo graded exposures, a dog is presented with progressively more aversive situations, provoking arousal in amounts that won't overwhelm it with fear or panic. The reactive dog is forced to give up its escape efforts as useless by systematically blocking movement away from the feared situation. These blocking efforts are continued until the dog's escape efforts subside. Initially, keeping the dog in motion is generally superior to having it sit or lie down and stay in the presence of a feared situation; as its fear is reduced, sit-stay and down-stay exposures can be added gradually. In addition to outward curving or angling approaches from the feared situation (e.g., crossing the street), a circular or spiraling pattern can be used. As the pattern is walked off, various types of food reward are covertly dropped at varied distances from one another. As the circle is completed, the same pattern is walked off a second time and the dog is encouraged to find the planted treats. Another technique involves having a stranger walk away from the dog while dropping treats every so often, including an occasional big surprise, as the dog follows at a safe distance from behind picking them up. After repeated graded exposures with response prevention, the dog gradually discovers that there is nothing to fear, thereby becoming more receptive and responsive to counterconditioning and safety training efforts (see *Response Prevention, Opponent Processing, and Relaxation* in Volume 2, Chapter 3). Interactive exposure involves physically directing the dog to engage in behavior that it would probably not choose on its own. Restraining a fearful dog in the presence of a fear-provoking object or person is potentially risky, so appropriate precautions should be taken. Consequently, when performing response-prevention procedures, appropriate restraint and equipment should be used (leash attached to a fixed-action halter or limited-slip/halter combination). Under some circumstances involving potentially aggressive dogs, a muzzle-clamping halter or muzzle may be a necessary precaution. When highly aroused with fear or rage, dogs should not be coddled with reassurance and protective petting. Such handling is not usually productive under such circumstances, and it may inadvertently make things worse or result in a redirected attack.

Counterconditioning and Interactive Exposure: Final Steps

Response prevention is particularly important when bringing the dog into close contact with the feared object or persons. Getting through this final barrier often requires a combination of response prevention, attention training, counterconditioning, and behavioral blocking techniques. In addition to inducing postarousal relief and relaxation effects, response-prevention procedures serve to block and extinguish instrumental escape and avoidance behavior via the disconfirmation of dysfunctional prediction-control expectancies, thereby preparing the way for additional cynopraxic behavior therapy and training efforts. Although graded exposure with response prevention may rapidly reduce overt fearful behavior, additional appetitive and emotional counterconditioning and play therapy may be needed to antagonize lingering emotional fear and prevent excessive anxiety as the blocking contingency is removed. Finally, by incorporating and reinforcing trained behavior with a composite of social, appetitive, and ludic rewards, an augmented safety bias can be developed to help generalize more confident behavior over varied situations previously eliciting fearful reactions.

Approach behavior is supported by bridging (DRO and shaping), petting, massage, food, conditioned odors, and play in order to produce new, attractive, and complex associations with the situation, to enhance attention and impulse control, to strengthen more appropriate and diversified patterns of behavior, and to establish active modal activity (exploring, investigating, experimenting, and so forth) conducive to interactive competence. Again, planting the situation with highly palatable food rewards that the dog can easily find on its own or with the aid of the trainer pointing them out can be very useful for motivating seeking and exploratory activity. A conditioned odor can be introduced to further facilitate the transitional process. For example, an odor that has been repeatedly paired with food via a scented squeaker bulb

(squeaker valve removed) can be delivered quietly with a modified carbon dioxide (CO_2) pump or a scented squeaker bulb, thereby modulating aversive arousal and enhancing food-related counterconditioning efforts. The olfactory signature used to facilitate and conclude posture-facilitated relaxation (PFR) training may be incorporated to produce associations and arousal incompatible with fear and enhance counterconditioning efforts associated with tactile stimulation (e.g., long and firm strokes of petting and massage), perhaps hastening the recruitment of a relaxation response (see *Olfaction and Emotional Arousal* in Chapter 6).

Interestingly, many (but certainly not all) fearful dogs, once within close contact with the feared situation, rapidly begin to relax under the influence of response prevention and the presentation of conditioned odors. During such exposure, the dog is vocally encouraged, petted and massaged, and rewarded with different types of food presented in varied amounts and frequencies. Rewards are presented in association with a highly conditioned bridging stimulus in accord with a DRO or shaping contingency or in the context of attention training. A dog's willingness to accept food at such times is a propitious sign, because it indicates that fear is either attenuating or at least not increasing. In general, the dog's willingness to accept food is a fairly reliable, but not foolproof, way to monitor nascent emotional changes incompatible with fear, whereas the loss of appetite is a useful barometer for gauging fearful interference. Evidence of progressive relaxation in response to massage is also a promising indicator, since a dog cannot be tense and reactive while at the same time remaining relaxed and calm.

Targeting-arc Training

As the result of socialization deficits, abusive or traumatic handling, or behavioral stress (anxiety and frustration associated with disorderly social interaction), dogs may become progressively reactive, showing signs of hypervigilance, anxiousness or irritability, and an acquired inability to respond adaptively to signals of threat or loss (see *Inclusion Criteria* in Chapter 5). A chronic exposure to attractive and aversive stimulation lacking order and consistency may exhaust or degrade attentional and comparator functions, giving rise to persistent frustration, anxiety, or both (helpless-panic spectrum), and an inability to produce reward via executive mediated comparator networks and positive prediction error. As a result, such dogs may become progressively reactive to environmental stimuli, showing a preferential sensitivity toward signals of punishment (loss and threat) and an affinity for fight/flight reactivity. Such reactive-type dogs appear to be prone to develop fears as the result of aversive sensitization. Paradoxically, though, despite their enhanced sensitivity to signals of punishment, such dogs often show striking deficits with respect to avoidance learning and nociception, apparently obtaining little reward as the result of successful avoidance (see *Post-traumatic Stress Disorder* in Volume 1, Chapter 9).

Training the orienting response to a high degree of reliability is of critical importance and value in preparation for both graded interactive exposure and counterconditioning efforts (see *Attention and Autonomic Regulation* in Chapter 8). In the case of highly reactive dogs, however, a variation of attention training focusing on the targeting arc of several sensory-analyzer systems (i.e., auditory, visual, olfactory, tactile, and kinesthetic) may yield additional benefit as a starting point. Targeting-arc training (TAT) is based in part on distinctions drawn by Konorski (1967) between targeting and orientation reflexes (see *Targeting Reflex* in Volume 1, Chapter 6). The targeting arc is a rapid adjustment of a sensory analyzer to an environmental event, captured or sandwiched between an orienting stimulus (e.g., squeaker, hand movement, odor, touch, or prompt by leash) and bridge stimulus (clicker). The targeting arc is akin to a behavioral snapshot delineated by a stimulus response and a reward signal. For example, the auditory targeting arc consists of a slight sideways head movement or ocular orientation toward the source of stimulation. TAT is introduced in a relatively distraction-free environment with an ambient odor (e.g., orange

or orange-lemon mix) delivered by an aquarium pump and diffuser. During TAT, the dog is first trained to take food from a closed hand flicked to the side (see *Introductory Lessons* in Chapter 1). TAT is focused on the split-second adjustment when the dog alerts to the orienting stimulus, whereupon the trainer clicks and flicks the closed right hand to the side, causing the dog to approach and take the food reward. A squeaker scented with the ambient odor is gently squeezed just before the hand is opened to deliver the reward. The targeting arc is a micro-control module consisting of reflexive and instrumental elements and organized in accordance with an appetitive control incentive. Initially, TAT is performed in the context of a varied DRO schedule, but is gradually superseded by a shaping contingency (e.g., following the trainer's body or tracking the movements of the right hand) and training the dog to come, sit, stay, and attend (i.e., make and hold eye contact in response to its name).

As a gate between the environment and executive analyzing and organizing functions, the targeting arc mediates selective attention and impulse control, providing an anchor for subsequent training and a conduit for manipulating appetitive and emotional establishing operations. If trained by ordinary means, using a repetitive orienting stimulus and a highly predicted reward, the orienting response rapidly habituates and plateaus. However, by varying the sound of the squeaker and presenting variable rewards on a DRO schedule conducive to positive prediction error and dissonance effects, a highly potentiated orienting response is produced, perhaps helping to refresh and restore attention functions and renewing the dog's interest in reward, as well. In addition, since positive prediction error is conducive to adaptive modal activity, TAT provides a viable organizing platform for reward-based training and therapy efforts (see *Instrumental Control Modules and Modal Strategies* in Chapter 1). Attention therapy with TAT may help disorganized dogs to transition gradually from a reactive cognitive and emotional orientation to a more adaptive one that shows an increasing sensitivity and responsiveness to signals of reward and punishment.

PART 2: FEARS AND PHOBIAS: TREATMENT PROCEDURES AND PROTOCOLS

Dogs are prone to develop fears and phobias toward a wide variety of eliciting stimuli and situations (see *Phobia* in Volume 2, Chapter 3). Many of these problems are discussed in Volume 2. The purpose of the following is to examine common phobias and to explore various methods for reducing them (see *Classical Conditioning and Fear* in Volume 1, Chapter 2). Remedial training for phobic dogs follows a regular course of events regardless of the specific fear involved. The first step is to define the functional and structural limits of the problem accurately, that is, the what, when, where, and how of its occurrence (see *Assessment and Evaluation of Fear-related Problems* in Volume 1, Chapter 3). This information can then be used to select an appropriate training program. Most of the fear-reducing techniques described are based on experimental studies involving fears produced by aversive conditioning, typically involving electrical shock; that is, the studies are largely limited to understanding the acquisition and extinction of the fear of pain. Fearful behavior presented by companion dogs is typically far more complicated, and the originating causes are often unknown and may emerge quite independently of any identifiable experience of pain. Further, it is virtually impossible to duplicate the highly controlled conditions of a laboratory in a home or clinical setting (Baum, 1989). Consequently, in addition to scientific knowledge, a significant amount of common dog sense and creative problem solving is needed to treat canine fears and phobias successfully, making cookbook protocols quite beside the point.

FEAR OF PAIN AND DISCOMFORT

Common fears associated with pain include grooming, handling, nail clipping, various veterinary procedures, and improper training procedures. Many conditioned fears associated

with pain can be prevented by means of latent inhibition and other habituation procedures performed early in the dog's development (see *Habituation, Sensitization, and Preventive-exposure Training*). Some dogs appear to be more sensitive to touch and prone to develop persistent fears associated with discomfort and painful handling. The usual procedures used for resolving such problems employ some combination of graded interactive exposure with RP-CC. Although conscientious efforts should be made to countercondition a fearful dog with treats and relaxing massage while it undergoes progressive exposure to the feared activity, it is imperative that avoidance and escape be blocked. Very often in such cases counterconditioning efforts will achieve only a small portion of the desired effect. Response prevention using physical restraint followed by massage as the animal begins to relax can be very useful. It is important for the dog to become relaxed before it is released from restraint. In the case of dogs that become highly reactive, they should be held in restraint (with massage) for 3 additional minutes after the last strong effort to break free. Excessive sensitivity to touch and contact aversion appear to play significant roles in the development of some aggression problems. Dogs exhibiting pain-based fears may resort to aggressive efforts to escape restraint during response-prevention procedures. Consequently, a muzzle or other adequate restraint may be necessary, at least until the dog learns to recognize that it is safe and will not be hurt during the training procedure. Persistent fears based on past painful experiences are usually responsive to graduated exposure with response prevention and counterconditioning.

STORM AND THUNDER PHOBIAS

The vast majority of noise phobias involve thunder or loud percussive sounds such gunshots or firecrackers. Shull-Selcer and Stagg (1991) reported that 93% of cases (N = 30) of dogs with noise phobias involved fear of thunder and other loud noises (e.g., gunshots, fireworks, backfiring, or cap guns). Occasionally, a critical precipitating event can be traced in a dog's history that helps to explain its fear of loud noises, such as a particularly strong aversive event that has occurred in close association with the eliciting noise. Perhaps the most common cause is sensitization resulting from intense exposure to a loud noise (thunder, fireworks, gunfire, and so forth). Such highly aversive events may permanently alter a dog's fear and escape thresholds by sensitizing alarm-threat pathways mediating fear and startle (Koch, 1999), making it excessively reactive to noises and prone to exhibit persistent fear in response to minimal provocation. Finally, some dogs may simply exhibit a strong genetic predisposition leading to increased sensitivity to loud noises and a low-threshold acoustic startle response (Royce, 1955).

Prognostic Considerations

Unlike conditioned stimuli that acquire their fear-eliciting properties by way of startling or traumatic events, thunder phobias may develop with little or no evidence of extraordinary associative conditioning; that is, they are biologically prepared (see *Biological Predisposition and Preparedness* in Volume 2, Chapter 3). Further, in the case of noise-sensitive dogs, thunder and other loud percussive noises represent an unconditioned source of startle and fear. Stimuli that evoke fearful reactions without conditioning may do so through reflexive and hardwired neural pathways that may be shielded from the effects of graduated exposure, habituation, and counterconditioning—procedures that are notoriously prone to rebound effects, spontaneous recovery, and other savings (Kehoe and Macrae, 1997; see *Spontaneous Recovery and Other Sources of Relapse* in Volume 1, Chapter 6). Several other factors mitigate the effectiveness and efficacy provided by these procedures in the case of storm and thunder phobias. Most dogs that are afraid of thunder can learn to tolerate recordings of thunder if the sound effects are presented at sufficiently low levels while they are being massaged or eating food; they may even gradually accept more realistic recordings and loud playback of thunder sounds, but the conditioning may not transfer to other situations involving the actual sounds and ambient stimuli associated with real storms. Further, the benefits of countercondi-

tioning are largely dependent on the presence of the owner together with unconditioned stimuli (e.g., food and massage) evoking arousal incompatible with fear.

Unlike many common fear-eliciting situations, avoidance and safe escape from storm activity are not possible, although a dog may find some degree of momentary relief by hiding or clinging to the owner. Since avoidance and escape are not practical coping strategies, it is imperative that emotional fear be modulated through a variety of means. With help, highly fearful dogs can learn to cope passively with their fear of thunder (ultimately this may be the best that one can expect), but such efforts may not result in permanent change. Controlling fear associated with thunderstorms can be extremely frustrating and subject to recovery and relapse effects. Excessive fear represents a significant welfare concern and, in cases involving extremely fearful dogs that show a refractory response to behavior therapy, veterinary medical intervention should be considered. Behavior therapy combined with appropriate anxiolytic medication can make the process less stressful for both owners and dogs. Providing thunder-phobic dogs with prophylactic desensitization and medication during times of the year when storm activity is most likely to occur may help to modulate or manage symptoms, perhaps the best that one can expect in severe cases.

The prognostic picture for moderately fearful dogs is much better. Even in the case of moderate storm phobias, though, controlling fear of thunder is complicated by a variety of difficulties. The foremost difficulty in this regard is that thunder is not easily predicted and controlled. For example, a dog may be at home alone while the owner is at work when the storm occurs, making it impossible to organize appropriate fear-reducing efforts to head off excessive fear. This consideration is particularly relevant to separation-anxious dogs, whose distress at being left alone may add to their susceptibility to thunder-elicited fear. Even under ideal conditions, with the owner present, control over the frightening event is compromised to the extent that its intensity varies widely according to the strength of the storm and where lightning happens to strike. This lack of control also extends to various antecedent and extraneous stimuli (contextual influences) associated with the thunder itself. Ultimately, the best approach to managing thunder phobias is by means of preventive-exposure training (latent inhibition) starting at an early age (see *Habituation, Sensitization, and Preventive-exposure Training*). Since the exact causes underlying the development of storm and thunder phobias are unknown, methods for preventing them are based on reasonable speculation and training lore. Many young dogs show some degree of apprehension with the approach of a storm and may exhibit signs of growing fearful arousal during thunder and lightning. Encouraging confidence at such times by engaging them in tug games or ball play may be very useful. Going for walks in the rain, playing fetch, or having the dog perform a set of basic training exercises as the storm approaches may also help it to cope better with storms.

Behavioral Signs and Indicators

As a storm approaches, dogs may become progressively nervous and apprehensive, often seeking close contact with the owner or anxiously searching about the house. Fearful arousal intensifies as the storm nears, causing dogs to increase fearful activities and present increasing signs of restlessness and sympathetic arousal (e.g., panting and trembling). Some dogs may seek close comfort contact, leap on the owner's lap, or search frantically for a place to hide. Upon hearing a lightning strike nearby, fearful arousal may become even more pronounced and panicked. If outdoors, dogs may attempt to run off or dig back into the house (Voith and Borchelt, 1996). Other dogs kept inside the house may search for a way outside, often resulting in significant damage to window casings and door frames; some highly aroused dogs have jumped through glass windows and screens. Finding that escape is not possible, they may run to a bedroom or other areas of the house in search of safety. Many thunder-phobic dogs hide in closets, where they may cause significant damage to flooring and drywall by scratching and digging.

In an internet survey, McCobb and colleagues (2001) found that nearly 50% of those dogs that hide do so in bathrooms. Some of these dogs appear to be particularly attracted to tubs and showers as places of retreat. Theorizing about the motives compelling dogs to seek out tubs and other bathroom fixtures, Dodman (1996) has fashioned a dubious hypothesis to explain this predilection of canine thunder phobics. Based largely on reasoning from anecdotal evidence and hearsay, he speculates that static electricity may play a powerful role in the etiology of storm phobias. The theory purports that dogs may receive static electrical shocks during storms, causing them significant fear and distress. According to Dodman's hypothesis, fearful dogs may be seeking metal pipes and other grounds (water) to discharge static electricity safely from their bodies, which he believes builds up in their coats during storms. Years ago, Whitney (1964) proposed a similar theory, suggesting that some thunder phobias may be related to storm-related electrical stimulation. Whitney argued that dogs may be more sensitive to small electrical shocks than are people because dogs have greater amounts of salt in their blood. To reduce the risk of static shock, Dodman recommends various measures to prevent and reduce static buildup (Dodman, 1999), such as misting the dog with water, rubbing it down with a used sheet of fabric softener, or treating its feet with an antistatic spray. Unfortunately, very little in the way of compelling data or empirical evidence is provided to support the static electricity theory.

Social Contagion and the Fear of Thunder

Some authorities, most notably Beaver (1982, 1983), have suggested that storm and thunder phobias may be facilitated by a social contagion and reward. According to this theory, storm phobias are learned or worsened as the result of social attention given to dogs by owners during storms:

> Lightning striking nearby is a neutral stimulus and a dog continues sleeping. The frightened owner pats the dog (an unconditioned stimulus) mostly for self-assurance. The dog quickly learns that it will receive social attention during thunderstorms and that trembling will increase the amount of attention. (1982:1348)

There are a number of problems with Beaver's notion of contagion-mediated fear. First, lightning and thunder are far from neutral; actually, thunder is a potent unconditioned stimulus capable of eliciting intense fear in a sensitive dog. A fear of lightning and thunder does not need the owner's help to be learned. In fact, loud noises can be used to support fear conditioning or to rapidly suppress behavior. If anything, lightning in the aforementioned scenario is a neutral stimulus related to thunder as an unconditioned stimulus eliciting fear. The function of the owner's pat might serve as an unconditioned stimulus in so far as it evokes an antistress response (see *Origin of Reactive versus Adaptive Coping Styles* in Chapter 4), but it is extremely doubtful that such contact comfort would evoke or mediate fear. As a result of the close forward association between lightning and thunder, distant flashes of lightning in the future may evoke in the dog an anticipatory apprehension of an impending thunder event, causing it to become uneasy with conditioned fear. Second, far from evoking fear-related behavior, social attention and petting under such conditions might actually help to attenuate a dog's fear, perhaps helping to avert excessive arousal and sensitization to the sound of thunder. Third, and importantly, many signs of fear, such as trembling and panting, are bodily expressions of involuntary sympathetic arousal that are not under the control of instrumental contingencies of reward and punishment. A dog may be able to control certain aspects of its behavior when under the influence of fear, but activities such as trembling are not among them.

To the best of my knowledge, no significant evidence exists to support the belief that phobias are acquired or worsened through social rewards. Strong contrary evidence does exist, however, supporting the view that contact comfort may provide a significant source of anxiety and fear reduction for dogs and

may be useful for reducing fearful arousal in the context of behavior modification (see *Effect of Person* in Volume 1, Chapter 9). The key is to provide such contact and reassurance in a constructive way that helps to modulate fearful arousal and guides the dog into more appropriate coping behavior. In some cases, it may be essential that the dog learn to seek refuge with the owner rather than pacing about aimlessly or running away to hide. The big problem with providing affectionate reassurance and petting for fearful dogs is that they may come to rely on the owner's emotional support rather than learning to cope with fear on their own. Unfortunately, this is an inherent problem with most counterconditioning efforts. While petting and vocal reassurance may inadvertently support active avoidance, the effect of social attention and contact is probably minor in comparison to the reward produced by the act of successfully moving away from or avoiding contact with the provoking stimulus or situation. For the majority of dogs, the reward maintaining avoidance behavior is the avoidance of the feared situation or stimulus. Owner-mediated reinforcement of avoidance behavior is primarily the result of allowing the avoidance response to succeed, with subsequent affection and reassurance provided by the owner paling in significance to the intrinsic relief and relaxation associated with successful avoidance (see *Fear and Instrumental Reinforcement* in Volume 2, Chapter 3).

Finally, the belief that thunder fears may be transmitted as a contagion that is transmitted from the owner to the dog is not supported by research designed to evaluate the effect of human anxiety on dog behavior problems (O'Farrell, 1997). Although anxious individuals appear to be more disturbed by their dog's phobic tendencies, O'Farrell was unable to find a significant correlation between the anxiety levels of anxious owners and the development of phobic behavior in their dogs. Social contagion may play a role in the etiology of some common behavior problems (see Speck, 1964), including some fear-related problems (Howard, 1992), but it does not appear to play a prominent role in the development of thunder or loud-noise phobias.

Evolutionary Significance of Escape Patterns

Dogs show a fairly typical profile of fear and panic behaviors associated with storm phobias, suggesting that their reactions may belong to a common phylogenetic origin. This general hypothesis suggests that phobias are not dependent on learning for acquisition (Menzies and Clarke, 1995), although learning may play a significant role in the maintenance and generalization of fear to incidental neutral stimuli present during the fear-eliciting event. The primary instinct evoked under such circumstances is self-preservation, as evidenced by the dog's extreme arousal and efforts to escape the stimulation. Perhaps, at least in some dogs, storm activity involving lightning and thunder may directly activate primitive species-typical subroutines dedicated to maximizing survival when faced with natural catastrophes associated with lightning and thunder. Trapped within a house, dogs may feel threatened and vulnerable, causing them to run about in search of cover. As their fear and vulnerability increase, they may resort to other species-typical escape activities, such as biting, digging, and scratching. The failure of these various coping and escape efforts to obtain relief may stimulate a spiraling escalation of fearful arousal. Under future circumstances, frustrated escape efforts, now conditioned predictors of failure, may become potent elicitors of escalating fear. These observations underscore the importance of response prevention in the control of fear-related behavior.

Systematic Desensitization

Playing recordings of storms and thunder at progressively louder levels while dogs are maintained under the influence of incompatible arousal of sufficient strength to antagonize fear is the most frequently recommended method for reducing thunder phobias. While thunder sounds can be recorded and played back at varying volumes and degrees of realism, many aspects of the storm situation and ambience cannot be reliably replicated: illusion of sound coming

from a distance, window and wall vibrations resulting from thunder, changes in barometric pressure, dark and overcast skies, increased humidity and rain, realistic lightning flashes, sounds of wind and rain on windows, ozone level changes, and many other subtle nuances remain outside of direct manipulation or duplication. Also, given a dog's sensitive sense of smell, ambient odor changes associated with impending storm activity may play a significant role as a conditioned stimulus or contextual cue (Otto and Giardino, 2001). Furthermore, no recording can faithfully capture and duplicate the temper and violence of an actual thunderstorm. Consequently, many dogs that appear to respond positively to an artificial arrangement may do so knowing that the stimulation is not real. Most dogs rapidly learn to ignore recorded storm sounds, strobe flashes, subdued lighting, and so on, but probably do so knowing that the recorded sound and other effects originate safely within the house and while the owner is nearby. When left alone or when exposed to a real storm, previous desensitization efforts may not do much good. Since the beneficial effects of counterconditioning depend on the presence of emotional arousal that is incompatible with fear, any benefits acquired as the result of desensitization may be lost when an actual storm strikes, simply because the owner is not present to provide the accustomed appetitive stimulation, massage, and contact comfort.

The first step in the desensitization by counterconditioning is to determine whether the audio storm recording elicits a fearful response. If the recording proves effective, the next step is to find an audio level that is sufficient to evoke orientation but without eliciting fear. The thunder-phobic dog is initially exposed to the least evocative item on the list and then progressively challenged with more intense audio samples until the entire stimulus-gradient hierarchy is covered. Many variations are possible depending on a dog's temperament and the severity of its phobia. The desensitization hierarchy is treated as a guideline open to adjustment and modifications as they may prove necessary during training. The hierarchy should be as simple and short as possible, with additional items added as training progresses and such alterations prove necessary. Each step of the hierarchy should be worked on until both visible and inferred (anorexia) signs of fear are extinguished.

The key to successful desensitization is gradual exposure to as many features of the evoking stimulus and situation as possible, while at the same time maintaining the dog in a motivational state that is incompatible with fearful arousal. Several stimulus and situational dimensions should be considered when constructing an artificial desensitization hierarchy: similarity to the evoking stimulus; proximity (distance from the evoking stimulus has a significant bearing on the magnitude of the response); context (the presence of the owner, for example, during desensitization has a significant effect on fear levels; this the effect of person must be faded out gradually); intensity of stimulation (a loud sound typical elicits more arousal than a soft one); contrast (relative to surrounding ambience and competing stimulation); and stimulus continuity (whenever possible, evoking samples should be presented in a smooth progression of fear-eliciting increments).

The key to effective desensitization by counterconditioning is careful progression and patience. Between regular training sessions, a previously desensitized level of recorded thunder may played for extended periods for added benefit, especially at times associated with play activities and eating. By using an electronic timer, such samples can also be presented at low and progressively louder and more natural levels while the owner is out of the house.

The controlled circumstances of crate confinement are conducive to desensitization, but the crate must be introduced gradually and patiently with counterconditioning in order to avoid negative associations (see *Guidelines for Successful Crate Training* in Chapter 2). An air-pump odor dispenser and feeder is an easy way to deliver food rewards and olfactory stimuli while a dog is in a crate (Figure 3.5). The device is constructed from an aquarium air pump and a modified water dispenser. Air pressure is directed through pliable tubing and controlled by a touch valve and a three-way valve that diverts a

small amount of air pressure to a glass diffuser that is used to deliver a dilute odor. The air pressure directed to the diffuser should be adjusted to produce a minimal airflow, ensuring that most of the air pressure remains available to dispense the food. The tubing is attached to the water bottle by a plastic connector inserted into a small hole drilled into the side of the bottle. Also, to allow food to pass through the stem of the water dispenser, the steel-ball valve must be removed. As air pressure builds up in the water bottle, the soft food is forced out through the stem of the water dispenser. Since the air in the diffuser moves more freely than the air going into the water bottle, the arrangement results in the odor reaching the dog a second or two before the food is delivered, thereby providing a viable classical condition arrangement.

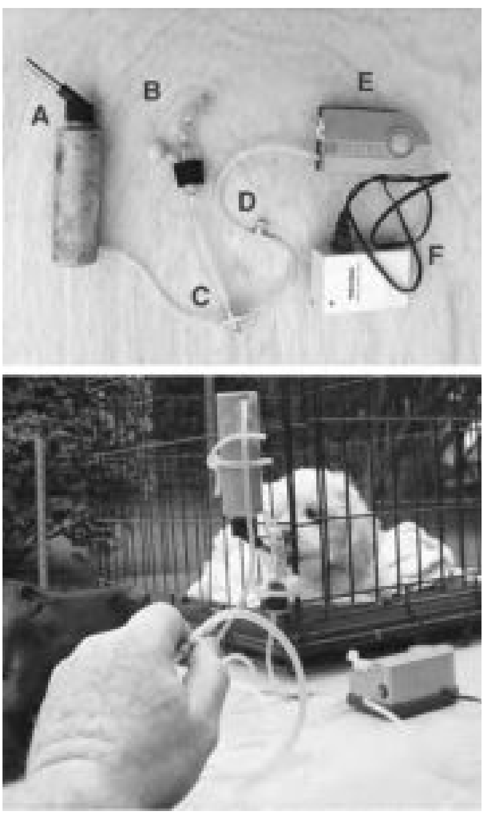

FIG. 3.5. Odor dispenser and feeder: (A) modified water dispenser, (B) glass diffuser, (C) three-way valve, (D) touch (screw) valve, (E) air pump, and (F) remote switch.

A touch valve situated in the main tubing regulates air pressure and allows the trainer to turn the odor and food presentation on or off. When the touch valve is covered with a finger, the air pressure rapidly builds and dispenses first the odor and shortly thereafter the soft food. When the finger is lifted from the touch valve, pressure is lost, and the odor and food stop dispensing. For remote operation, the touch valve can be sealed with a screw stopper, and a remote switch can be used to activate the air pump and control the delivery of food. This arrangement allows the trainer to stage desensitization conditions that more closely mimic situations when the owner is not at home—occasions when many phobic dogs are particularly vulnerable to thunder and other fears.

The persistence and resistance of storm phobias to extinction and desensitization efforts may, in part, be due to the brief duration of storm activity. Thunder storms typically roll in and roll out rapidly, perhaps not giving the dog sufficient exposure time to the stimulation to habituate naturally. As the storm subsides, the dog may experience significant emotional relief, negatively reinforcing preceding escape efforts, even though they had no effect on the storm's coming and going. Further, because the motivational arousal is extremely high, the potential effect of reinforcement at such times may be extremely strong and perhaps sufficient to establish persistent superstitious escape/avoidance behaviors. As a result, storm-associated cues may gradually become discriminative stimuli and establishing operations, setting the occasion for fear-related escape and avoidance behavior in the presence of stimuli associated with a storm. Consequently, during desensitization, dogs may be permitted to move around the room, but are not permitted to run off or hide. Efforts to hide or escape are prevented by keeping the dog on a leash or other restraint, as necessary. Some dogs may benefit from being restrained on a halter-type collar, an arrangement that enables the handler to control even very subtle escape/avoidance behaviors. Prior to performing desensitization procedures, the dog should receive intensive attention and basic training (see *Graded Interactive Exposure*).

Sample Hierarchy

Baseline information about a dog's reaction to thunder should be recorded, including various signs of fear. A chart and behavior journal should be kept to record procedures used and the dog's response to therapy. Heart rate is a sensitive measure of fear and should be measured and recorded at the beginning and end of each session. The outline of desensitization by counterconditioning described below is intended to provide a general picture; many variations and intermediate steps and subsets may be involved, depending on the specific requirements of a dog:

- The dog is exposed to low-level audio recordings of storm sounds (15 to 30 minutes or longer) while moving about, playing tug, chasing a ball, or receiving food and petting after coming when called. All efforts to leave the situation are prevented by keeping the dog on leash. Food rewards can be delivered from a hand holding a scented squeaker bulb. The bulb is squeezed just before the hand is opened to deliver the reward. Presenting the conditioned odor during simulated and real storms may augment appetitive counterconditioning effects. The conditioned odor is presented via an aquarium pump and diffuser before turning on the recording and continued for 3 to 5 minutes afterward. An easy-to-construct diffuser can be made with some rubber tubing and a small bottle with a cap (see *Taction and Olfactory Conditioning* in Chapter 4).
- The dog is exposed to low-level audio recordings of storm sounds under subdued lighting, flashes of light (camera strobe), and a fan blowing curtains while the dog moves about, plays tug, chases a ball, or receives food and petting after coming when called.
- The dog is exposed to a progression of stronger audio sounds of thunder with subdued lighting, remote flashes of light, a fan blowing curtains, and a sprinkler casting water against a window while the dog moves about, plays tug, chases a ball, or receives food and petting after coming when called. Previously desensitized levels are presented randomly during the day while the dog is playing, eating, or sleeping.
- The dog is exposed to increasing intensities (starting at a low level) of audio-recorded sounds while receiving PFR training.
- The dog is exposed to a progression of stronger audio sounds of thunder under subdued lighting, remote flashes of light, and a fan blowing curtains while the dog is in a crate receiving treats.
- The dog is exposed to taped recordings of thunder at natural intensity along with other storm-related sounds and movements while in a crate, with the owner on the other side of the room.
- The dog is exposed to taped recordings of thunder at natural intensity along with other storm-related sounds and movements while in a crate, with the owner out of the room.
- The dog is taken outside in the presence of an advancing storm and walked and engaged in various training activities, tug games, and ball play. Attention control is maintained by calling the dog's name, squeaking or smooching, and reinforcing appropriate orienting behavior.

At the conclusion of each step, the audio storm should be gradually turned down, mimicking the retreat of an actual storm. Perhaps the most effective use of counterconditioned audio storm recordings is to present them during actual storm events, thereby providing means to continue stimulation for a sufficient time to promote habituation and extinction and to reinforce behavior incompatible with fear. Counterconditioned audio storm sounds may exert a significant restraining influence on fear occurring in the presence of actual storms. The conditioned odor is presented just before the storm appears, followed by the audio storm, and continued during the full duration of the storm. The audio storm should stay on even after the actual storm has subsided, and continue until the dog's fear attenuates. The olfactory stimulus should be continued for 3 to 5 minutes after the audio storm is gradually tapered off. The combined presentation of the counter-

conditioned audio storm and the conditioned odor may help to dampen fearful arousal elicited by an actual storm event (see *Safety Signal Hypothesis* in Volume 1, Chapter 8). In some cases, earplugs fashioned from pliable silicone may be helpful, at least temporarily. A short knotted string should be imbedded in the silicone wad to make its removal easier.

Fear of Loud Noises and Household Sounds

A dog's response to loud noises is mediated by a variety of physiological and behavioral systems. Startle to loud sounds is reflexive and depends on genetic predisposition (sensory and behavioral threshold variability) and experience. The evoked startle response triggers a cascade of biobehavioral events preparing dogs for defensive action. Dogs exhibiting a low acoustical threshold may exhibit a very pronounced startle response to loud percussive sounds (e.g., gunfire or fireworks), even when they occur at some distance away, whereas dogs with a high acoustical threshold may simply orient in the direction of stimulation or ignore it altogether unless it occurs nearby. A dog's response to startling stimulation appears to be strongly affected by genetics, but experience exerts a powerful modulatory influence over functional thresholds controlling the latency and magnitude of the canine acoustical startle response. An increased responsiveness to auditory stimulation can be produced by fear-potentiated startle and sensitization (Koch, 1999). In the presence of ambient stimuli previously paired with aversive stimulation, loud noises or unfamiliar sounds may produce a potentiated startle response even though those auditory stimuli had never been paired with aversive stimulation in the past. For example, excessive punishment may result in the owner becoming a conditioned aversive stimulus. In the presence of such an owner, a dog's response to auditory stimulation may be significantly potentiated as the result of fear. Similarly, a wide variety of aversive conditioning events can permanently alter startle thresholds to auditory stimulation. Such fear-potentiated startle can have both adverse and beneficial effects on a dog's training and adaptation.

Sensitization occurs when a dog is exposed to an intense and unexpected auditory event, which subsequently results in significantly lower acoustical thresholds in response to that sound and other loud noises, as well. Sensitization appears to have played a role in the following case described by Humphrey and Warner (1934):

> One day she stopped him for a curb at a street crossing and waited for a large truck, halted by the traffic lights, to move on. As the lights changed and the truck started it back-fired in the face of the dog. The master, who was shell shocked as well as blind, jumped backward, yanked, stepped on and fell over his dog. Thus, the ear-pain from the back-fire was followed immediately by the body-pain of the trampling. The animal was retired from blind-leading at once because it was found that she had become extremely oversensitive to sound. After a year's service as a companion in a private home she seems to have outgrown the effects of the shock and to have become again gun-sure. She has not been returned to blind guide work, however, for it is feared that in a difficult traffic situation the occurrence of another noise, even though not so loud this time, might cause her to act erratically and endanger her man. (151)

The authors attribute the dog's fear to a conditioned association between the sound of backfire and painful stimulation, but a more likely cause is sensitization and the ensuing chaos and loss of control and predictability associated with the event.

Dogs exhibit varying degrees of stress-related behavior and physiological changes in association with noisy environments. Although many dogs appear to be remarkably undisturbed by loud noises so long as they are presented in nonstartling increments, sudden and loud noises may produce a surge of adrenal hormone activity indicating HPA-axis activation (Stephens, 1980). Thalken (1971) found that laboratory beagles exposed to a total of 2 hours of loud noise (120 dB) in repeated 30-second to 5-minute doses over an 8-hour period did not exhibit a significant increase in glucocorticoid activity. Similarly, Beerda and colleagues (1997) found minimal heart-rate and cortisol changes in dogs exposed to moderate stimulation levels under 87 dB. However, one dog exposed to 95-dB auditory stimulation for several minutes

showed increased cortisol activity and other signs of behavioral stress: tongue exposed, nose licking, paw lifting, and shaking. In a subsequent study involving strong, momentary auditory stimulation, the authors reported that repeated exposure to a momentary blast (1 to 2 seconds) from a foghorn (110 to 120 dB) resulted in significant physiological and behavioral evidence of stress, including a pronounced cortisol surge that returned to baseline levels after 60 minutes (Beerda et al., 1998). The researchers also found that the blast of the foghorn produced more cortisol activity than produced by moderately strong levels of repeated brief electrical stimulation delivered by a remote electronic collar (Tri-tronics 100 A set at level 8). Loud barking and other sources of noise are common in situations where dogs are housed together, with noise levels frequently exceeding 120 dB in kennel situations (Sales et al., 1997). Thalken's findings do not necessarily suggest that exposure to loud noise is not stressful; instead, the apparent absence of stress may be the result of previous exposure and habituation to loud noises in the dogs studied. Also, Thalken's failure to find evidence of stress in response to loud auditory stimulation may be attributable to breed-specific peculiarities affecting auditory arousal in beagles. As hunting dogs, beagles may have been selected to exhibit an elevated acoustical threshold for loud noises, enabling them to work in close range to the blast of a shotgun. In fact, dogs of different breeds exhibit varying levels of emotional reactivity to startle-eliciting stimulation (Mahut, 1958), making generalizations concerning fear and stress in dogs based on the study of a select breed or small group of represented breeds highly questionable. Finally, there is significant individual variability in the way dogs respond to startle- and fear-eliciting stimulation, further militating against such generalizations.

Desensitization by counterconditioning or habituation follows the same basic procedures as already described. The fear-eliciting effects of loud noises can be attenuated either by presenting them at a distance or by various muffling techniques. Hart and Hart (1985) have described a method whereby a nest of six cardboard boxes is used to muffle the sound of a starting pistol. Removing one box at a time, progressively making the sound stronger, produces a graduated effect necessary for desensitization. A more convenient method, and one that allows dogs and handlers to move about freely indoors and outdoors, is to wrap the starting pistol in a towel. Unwrapping the pistol one layer at a time gradually increases the intensity of the sound produced, thereby providing a means to present progressively louder samples of gunfire. Another way to present fear-eliciting noises on a gradient of intensity is to have a helper approach at various angles or orientations relative to the dog while periodically firing the pistol. Graded exposure can also be carried out with the dog on a 50-foot long line, allowing it to move to a safe distance before discharging the pistol or cap gun. As the dog starts in response to the stimulus, it can be called back, rewarded, and released again. In cases, where more precise control over the dog's distance is required, an active-control line can be used instead.

In addition to presenting the fear-eliciting stimuli on a gradient of increasing intensity, various conditioned and unconditioned counterconditioning stimuli are presented to offset fearful arousal. The choice of procedure depends on the magnitude of a dog's fear. Various techniques are employed, including play activities (tug and fetching) and romps, systematic desensitization by graduated counterconditioning or habituation, and response prevention. The most common method involves presenting a treat immediately after the noise is made, thereby training the dog to expect food whenever the gunshot occurs—an expectancy that is incompatible with fear. In some cases, the dog is prompted to sit, whereupon a sound stimulus just strong enough to capture the dog's attention is presented. The dog's attention is then immediately diverted from the event by calling its name, squeaking, and so forth. As the dog turns in the direction of the handler, a conditioned reinforcer "Good" or a click is presented and followed by food. Randomly altering the size and type of the reinforcer may help to magnify its effect, both in terms of conditioned reinforcement and the elicitation of appetitive and emotional arousal incompatible with fear.

Whenever possible during appetitive counterconditioning, the dog should be kept moving forward. Forward movement and standing are preferred to having the dog sit and wait; however, sit-stay training may be a necessary transition in the case of dogs likely to show strong escape or avoidance efforts in response to the feared stimulus. Sit-stay and down-stay training is also preferred in the case of dogs exhibiting reactive aggressive behavior in association with fear. Forward-oriented movement appears to have a functional affinity with the seeking system, mediating an increased sensitivity to signals of reward and approach, whereas remaining still or turning away or walking backward are motor correlates of the behavioral inhibition system and a heightened sensitivity (hesitation or avoidance) to signals of punishment. Lightly spraying a conditioned odor from a modified CO_2 pump just prior to the presentation of the feared sound appears to facilitate appetitive counterconditioning and reduce startle reactivity (see Miltner et al., 1994). The scent of orange (Lehrner et al., 2000) and lemon (Komori et al., 1995) appears to have some intrinsic anxiety- and stress-modulating properties that might be useful in fear control and management. A dilute lavender fragrance (Motomura, 2001), chamomile (Roberts and Williams, 1992), or vanillin (Miltner et al., 1994) may also possess intrinsic properties of value for modulating fearful arousal and adjusting acoustical startle thresholds. In the case of strong and startling sounds, timing the presentation of a diminutive sound to occur immediately before the startling event may help to reduce fearful arousal via prepulse inhibition and enhanced cognitive regulation and organized processing (see *Interrupting Behavior* in Chapter 1). Further, presenting a target-arc stimulus contiguously with the onset of the feared event may produce a potent fear-incompatible orienting response (see *Target-arc Training*). Exposure with prepulse inhibition and TAT may be particularly useful for the prevention and control of noise fears involving sensitization in association with discrete eliciting events (e.g., gunshots).

In addition to loud noises, many dogs react fearfully to unfamiliar sounds. Repeated exposure with playful encouragement and response prevention can be extremely effective in such cases. Finding a constructive way to have a fearful dog interact with the object producing the unfamiliar or startling sound can also be helpful. Many dogs exhibit fear toward motor-driven household appliances; a fear of vacuum cleaners is especially common. Since these sorts of stimuli are fairly easy to control and present in a form that allows the dog to habituate gradually, they are fairly easy to resolve, perhaps explaining the relative infrequency of such fears presenting for treatment. Shull-Selcer and Stagg (1991), for example, found that, of 30 noise-fearful dogs, 7% exhibited fear toward television or stereo sounds and only 3% presented fear related to the sound of vacuum cleaners. Some dogs exhibit persistent fears associated with the switching on of furnace relays, causing them to awake at night and pace or pant nervously. A furnace-related fear should be considered in dogs exhibiting sleep disturbances that involve pacing and other signs of fear (e.g., panting and trembling).

Fear of Sudden Movement or Change

An innate expectancy bias toward sudden movement or change appears to underlie many fears expressed toward moving objects, such as cars, bicycles, joggers, and skaters. Additive effects are likely to occur when fear-evoking stimuli are both novel and encountered in unfamiliar locations (see *Expectancy Bias* in Volume 2, Chapter 3). Consequently, initial exposure and desensitization should be carried out in familiar places and gradually extended to areas progressively less familiar to the dog. A useful method is for the owner to introduce the feared object or activity as part of a play activity. For example, a ball can be thrown in the vicinity of a bike resting against a tree. Gradually, other exposure elements are added (someone standing with a bike, rolling it, running with it, and so forth) together with various counterconditioning efforts as necessary to reduce fearful arousal. Typically, the dog is prompted to sit in the presence of the fear-evoking stimulus, starting at a distance where the stimulus elicits an orienting response but does not elicit fear. With

repeated exposures, the size and type of the food reward given to the dog should be varied to maximize positive-prediction-error effects. Dogs that are fearful of bicyclists or joggers can be introduced to the feared stimulus through fear-graded interactive exposures. For example, close interaction with a bicyclist helper can be accomplished by first having him or her stand next to the bike, followed by a walk in which the bike is rolled along next to the dog. If the dog tolerates this level of exposure, the next step can involve having the rider mount the bike and ride slowly nearby. Finally, the bicyclist is instructed to ride by in a progressively more natural manner. During these various exposure exercises, the dog should be kept under control by heeling, sitting, or staying at the owner's side. A variety of food treats can be given in varying amounts to facilitate counterconditioning and shaping objectives. Repeatedly capturing the dog's attention with a squeaker and click at the earliest sign of incipient arousal and redirecting its behavior into more constructive action (e.g., sitting or standing quietly in place) in the presence of the feared object can help counter established escape/avoidance behavior.

Some dogs exhibit a global panic or generalized anxiety whenever taken outdoors, behavior that parallels symptoms reported by human agoraphobics. Low behavioral thresholds for fear may persist despite patient environmental exposure efforts. Such fear may develop without the involvement of any identifiable aversive event in the dog's history. An innate dread of loud sounds (e.g., gunshots or thunder) and abrupt movement is sometimes evident in such dogs from a very early age or may appear spontaneously as such dogs mature. Fears and phobias associated with an innate predisposition may be controlled to some extent with behavioral and environmental management, but cure is not likely in these cases. Dogs exhibiting signs of global anxiety and fear should be referred for veterinary evaluation and possible treatment with appropriate medications (e.g., SSRIs) prior to the initiation of behavior therapy and training.

FEAR OF HEIGHTS

Many puppies exhibit a fear of heights when placed on a table or prompted to engage in some activity that poses a risk of falling, such as walking over a log bridge. The fear of heights, like other innate fears with phylogenetic origins, may be easily potentiated by pain associated with falling, making them prone to one-trial learning. For example, children may accidentally drop a puppy that they have picked up or frightened with awkward and insensitive handling. Another common fear associated with heights involves stair-climbing inhibitions, although such fears are probably more related to a competency deficit than a fear of heights. Such fear is particularly common in adult dogs that have not had adequate experience climbing and descending stairs. Some dogs will develop an aversion toward stair climbing or jumping in a vehicle as the result of bone- and joint-related problems, making a veterinary examination an important preliminary, especially in cases where fear or competency do not appear to be significant factors.

Intense fear is commonly associated with the acquisition of complex motor skills needed to interact safely with threatening situations. Mastering stairs is a good example of such habit learning involving a fear of heights. When first learning to climb steps, puppies are awkward and hesitant in their movements. In addition, they may show significant fearful arousal and freezing behavior. Alternately, they may race down the steps in a mad dash to escape the situation. As the result of practice, however, the motor skills needed to climb steps are gradually acquired, making their efforts progressively more natural and effortless. To some extent, a puppy's climbing behavior is reinforced by the relief and relaxation it gets as it successfully reaches the top of the steps. Gradually, the initial fear of heights is overcome by the development of skillful climbing and improved confidence. Learning to climb steps exemplifies the importance of competent control and skill to overcome certain natural fears.

Puppies are usually taught to climb stair steps by placing them on the uppermost step and luring them with treats and encouragement. As the necessary skills and confidence improve, more steps are added until the puppy can climb all of them at once. After learning how to climb up the stairs, the same general procedure is used to teach puppies to

climb down. Confidence building by vocal encouragement and treats play an important role in such training and should be given to puppies following every successful trial. Successful climbing is associated with significant emotional relief and relaxation, effects that may gradually help to countercondition a puppy's initial fearful reaction to steps as well as provide a source of reinforcement for climbing behavior. During the training process, the puppy should be kept on a leash to provide physical support and prevent it from falling down the steps.

As puppies learn to maneuver themselves successfully on stairs, they become progressively relaxed and confident—fearless—when climbing steps. However, dogs not exposed to stair climbing as puppies, or dogs that have been traumatized as the result of falling down steps, may prove to be much more difficult to train by using methods based on the foregoing procedure. Inexperienced dogs may resist climbing steps even after many hours of conscientious desensitization and behavioral shaping. Misguided efforts to compel them to climb by withholding meals (sometimes for days) until they finally climb the steps to get food are usually ineffective and should be avoided. Adult dogs that are afraid of steps can benefit from playful exposure to jumping over things while on outdoor excursions, climbing inclined surfaces, walking along a curb, and repeatedly stepping up and down from a low curb. Such fearful dogs may be more willing to climb low steps (e.g., the long sort sometimes found in front of schools and office buildings) when the steps are approached at an angle and then progressively approached more directly. The process involves playful and gradual exposure to progressively more difficult step-climbing challenges.

The stairs may be altered to make them easier for the dog to climb. Borchelt (1997) has suggested laying bricks side by side in front of the stairs to make the first step easier to take. Alternatively, a length of carpeting can be attached to the first few steps and extend several feet in front of the steps to provide the dog with a secure traction and "runway" up to the steps. Finally, the steps may be made less threatening to climb by covering them with a nonslip rubber runner or carpeting. Letting inhibited dogs observe a more confident dog climb steps may help facilitate a greater willingness to climb.

Given that such efforts have been attempted without success, directive exposure might be considered. In this case, the dog is physically prompting to climb by being hauled up and down the stair steps on a leash. In some cases, a wide harness can be used to support some of its weight. If a harness is used, a second leash should be attached to a strap collar for safety and enhanced control. The inhibited dog is repeatedly prompted to climb steps until relaxed compliance and enthusiastic climbing replace its resistance. Dividing the training objective into simple steps facilitates directive exposure. Initially, the dog may be prompted to climb two or three steps before being permitted to turn and climb back down again. If the dog is unwilling to climb back down, it is directed to do so with steady pressure on the leash. From the top of the steps, the dog is first prompted to climb down two or three steps before allowing it to turn and scamper back up. The opportunity to reverse directions and climb back down or up again may provide a significant source of skill and confidence building.

After a series of introductory trials, the dog is carefully hauled up and down the steps. Avoidance or resistance is consistently countered with enough leash pressure to break the dog's resistance and keep it moving. The dog's willingness to follow is reinforced with enthusiastic praise and encouragement by a helper (the owner) waiting at the top or bottom of the steps. It is imperative that the trainer does not hesitate or yield to the dog's sometimes-considerable resistance, but to drive headlong up or down the steps without taking notice of the dog's reluctance to follow. Once the dog is following the handler's lead, the directive prompt is faded and a controlling discriminative signal is added to the routine. The step-climbing behavior is repeatedly prompted over a session until the dog climbs steps with minimum prompting. With the conclusion of each successful trial, the dog is given 15 to 20 seconds of encouraging praise, petting, and treats. After a session of repeated trials, the dog is prompted into a down at the top of the steps and encouraged to relax with petting and massage for 2 to 3 minutes. The

successful session is followed by vigorous ball play.

Another common fear related to falling is associated with slippery flooring. Dogs exhibiting this fear may freeze when prompted to walk across waxed linoleum or wooden floors. When compelled to walk, they may move in a very awkward and poorly coordinated way. These problems are usually approached on two fronts. First, a carpet or vinyl runner is laid down to provide a safe pathway with good footing and traction. Second, the dog is walked over a piece of the runner in other parts of the house until the fear is not exhibited. In addition, the dog is prompted to lie down, sit, stand, and stay at various points on the runner. Next, a length of runner material is laid down starting in a separate room and crossing into the room containing the feared flooring. Treats can be put on the runner for the dog to pick up and eat, though most dogs exhibiting this type of fear may not be attracted to the food. Efforts to escape the situation are blocked, and the dog is prompted to move forward by leash and encouragement. Once the inhibition begins to break down, several passes are made having the dog move both into and out of the room. Rewarding objects and activities should be made contingent on the dog crossing the feared area. For example, the dog's meals, toys, and opportunities to go outside should all be preceded by its walking across the runner. The runner is gradually pulled back little by little over several days, requiring that the dog walk on more and more of the feared surface. Trimming nails back and treating the dog's paws with products to reduce slipping may be helpful in making stair climbing and walking on smooth surfaces easier for some dogs.

FEAR OF WATER

The psychological opposite of fear is confidence and relaxation—not appetitive arousal. Relaxation is a symptom or by-product of confidence. Without confidence, a dog simply cannot feel relaxed when faced with a potentially dangerous situation. The systematic training of skills needed by dogs to control feared situations competently serves to enhance their confidence while simultaneously reducing its fear (Figure 3.6). Coping adaptively with fear entails that a dog learn how to control the fear-evoking situation (see *Efficacy Expectancies* in Volume 2, Chapter 3). Fearful dogs often appear to be tense and worried about their ability to perform a feared activity or to control a potentially dangerous situation, rather than being especially fearful of the object or situation itself. In contrast, nonfearful dogs exhibit a more relaxed and confident attitude toward such situations as the result of a history of competent interaction and success. Many persistent fear conditions are the result of dogs not knowing what to do or not possessing sufficient skills and confidence (practice) to do what they need to do to control potentially dangerous situations. For example, many dogs are fearful of water and may refuse to go into it even when in the company of other dogs who enjoy water (positive models). Other dogs may not only lack the necessary skills to control a feared situation, but may actively fear stimuli associated with it. For example, some dogs are so fright-

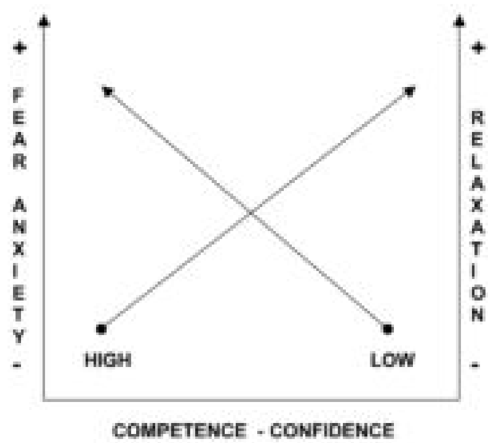

FIG. 3.6. Relaxation is a natural corollary of competence. As a dog's competence and confidence increase, fear is generally reduced as relaxation increases. Relaxation competes with the tenseness, worry, and vigilance associated with anxious and fearful states. The elation and relaxation associated with competent control over a potentially dangerous situation represent a powerful counterconditioning influence and source of positive reinforcement for dogs.

ened of water that they frantically scurry away from puddles to avoid coming into contact with it. In the case of some storm-phobic dogs, a single drop of rain can precipitate a major fearful episode.

Interactive exposure to water can be highly effective in the treatment of such phobias. Performing a variety of obedience exercises reinforced with food, play, and affection while near water is often beneficial. Gradually, the dog is progressively moved closer to the water until it is directed to walk into it or stay while standing in it. Once accepting the feel of water, stronger incentives, like an opportunity to play tug or fetch, are introduced near it. The play activity is gradually moved closer to the water until the dog is able to fetch things thrown into it. Walking at heel or fetching a ball while in water invariably teaches a dog many skills about interacting with water that can help improve its general confidence and attitude toward water. Probably the best way to prevent and overcome a fear of water is to train a dog how to swim.

Fear of Riding in Cars

The majority of dogs seem to look forward to car rides. However, some dogs, especially those that have not been exposed to car rides early in life (see *Habituation, Sensitization, and Preventive-exposure Training*), may be quite uneasy or fearful while in a car. The first step is to familiarize the dog gradually with the car. With car doors open, the dog is simply walked around the car, perhaps performing various obedience exercises or encouraged to play (e.g., tug or fetch) when near it. Any approach toward the car can be bridged ("Good" or click) and reinforced. Bonuses involving highly appetizing food items can be given in a pan that is placed progressively closer to the car. In some cases, the dog is tied to a tie-out that is attached to the car. At such times, the dog can be given a highly desirable chew item (e.g., rolled rawhide or a beef bone), and the car radio can be turned on. Graded interactive exposure and counterconditioning proceed through progressive steps until the dog willingly approaches the car. PFR training with an odorant signature can be very helpful. The conditioned scent is applied to the inside of open doors and at various other places on the outside of the car. Since the dog is highly motivated with approach incentives during homecomings, it may be useful to arrange for someone to let the dog out of the house at such times in order for it meet the owner at or in the car. At such times, the owner should get in the rear of the car and slide across the seat, giving the dog room to jump in. The excitement elicited by the owner's homecoming may offset fearful avoidance and increase the dog's confidence. As the owner gets out of the car, both doors should be left open. Depending on the dog's response, the owner might opt to get back inside the car and encourage the dog to follow. As the dog's willingness to jump into the car improves, the owner should prompt the dog to get in first. Over several trials, a progressively more natural pattern is introduced in gradual steps and reinforced. Feeding the dog by hand or putting food on the car seats and floor may encourage the dog to move about, explore the situation, and become progressively comfortable. At the conclusion of the session, the dog is given a brief period of ball play or a walk. Another alternative is to allow the inhibited dog to play with a more confident dog close to the car with both back doors open. The confident dog can be encouraged to jump into the car to get food previously thrown there and the reluctant dog encouraged to follow. In addition, a ball or other toy can be thrown into the car, perhaps causing the reluctant dog to jump in after it. Holding the reluctant dog back for 15 seconds or so may help to build a heightened enthusiasm to follow the confident dog into the car.

An unwillingness to get into a car may be related to a lack of confidence, stemming from inadequate training. Some dogs may refuse to get into a car, as though afraid of it, but once inside not show any significant signs of anxiety or fear. In such cases, various training efforts should be carried out to teach the inhibited dog how to jump in and out of the car. As in the case of stair-climbing inhibitions, a dog that strongly resists jumping into the car may benefit from directive exposure. In this case, the dog is repeatedly prompted to jump up into the car. Any resistance is consistently countered with sufficient force to compel the dog to jump. As the dog leaps

into the car, relief is associated with vocal encouragement, food, and petting. After 15 to 20 seconds, the dog is directed out of the car, and the procedure is repeated. Each trial is repeated in the same manner until the dog jumps up on its own. Once the dog is responding, a vocal cue such as "Hup" can be paired with the action of jumping into the car. At the end of the training session, the owner and the dog should remain in the car for 2 to 3 minutes, thereby obtaining benefits associated with opponent-relaxation effects. This period is associated with quiet petting, massage, listening to the car radio, and the presentation of an olfactory safety cue.

Dogs may develop fears about riding in the car as the result of traumatic events or a history of aversive consequences associated with car trips. For example, dogs that are taken in the car only for veterinary visits, especially if they have experienced painful procedures, may develop an anticipatory fear associated with car rides. When such causes are suspected, frequent rides that result in more attractive outcomes (going to the park, picking up children at school, and so forth) can help to counteract such fears. Some dogs who have been exposed to an automobile accident or abrupt stop throwing them around inside the car may develop a lasting fear that makes them uncomfortable in cars. The affected dog may pace back and forth, pant, whine, and in general appear to be unable to settle down. Such dogs may be aroused continuously during drives or become aroused only after a sharp turn or bump in the road. One advantage of this class of fears is that the duration of exposure can be controlled, making response-prevention procedures feasible. Smooth and straight rides(e.g., on expressways) can be taken during which the dog is appropriately restrained from moving about. In addition, the dog should be taught to sit and stay while in the car. As the dog shows signs of calming, the car can be pulled over and the dog taken for a walk.

FEAR OF ENCLOSED SPACES AND CONFINEMENT

Many puppies initially respond to crate confinement with intense fear and escape behavior. In an important sense, crate confinement is more like a trap than a den. Under natural conditions, a situation like a crate would be a serious threat to an animal. It is little wonder, therefore, that many puppies and dogs respond with intense aversion and distress when locked inside a crate for the first time. Unfortunately, many new dog owners simply put the puppy in a crate and leave it there to work through its distress alone, with little appreciation for the potential harm done by such treatment. The puppy may subsequently eliminate in the crate as the result of ensuing distress or because the owner may neglect to take it out on a timely basis, thereby making an already problematic situation much worse. Puppies that eliminate in the crate may be further stressed by abusive after-the-fact punishment and water deprivation initiated to correct the elimination problem. Because of work and school schedules, the puppy may spend the vast majority of the day in a crate. Thus, life goes by with the puppy rapidly transitioning through extremely sensitive and influential developmental periods under the adverse and deprived conditions associated with excessive crate confinement and unsympathetic rearing practices. The net result of such treatment is sustained and inescapable stress, perhaps quietly sensitizing neuroendocrine systems in ways that may make the puppy vulnerable to develop serious adjustment problems in adulthood. As a result of such risks, crate confinement should be introduced through gradual steps involving desensitization by counterconditioning and associated with compensatory measures to offset stress associated with its use (see *Crate Training* in Chapter 2). Although gradual exposure is much better and likely to result in fewer adverse side effects, crate confinement should still be used with a proper degree of concern for potential harm. Crate confinement should be used in a limited way for specific purposes of space management and training, but not as permanent way of life (see *Adverse Effects of Excessive Confinement* in Chapter 2).

In the case of adult dogs, many show a persistent aversion toward crate confinement in association with various adjustment problems, including separation distress and fears (e.g., storm phobias). Such problems need to

be addressed and ameliorated first in order to effectively modify the dog's adverse response to confinement. In the absence of contributing adjustment problems, dogs exhibiting a strong aversion to crate confinement are usually responsive to some combination of graded interactive exposure with RP-CC and shaping. For example, the dog is trained to obtain food by approaching the front of the crate. Initially, treats are dropped on the floor just in front of the crate and then gradually tossed inside of it. Some dogs appear to be afraid of the crate pan and the noise it makes as they step on it. Temporarily, removing it or laying down a blanket or rug can be very helpful in such cases. To encourage more willingness to approach the crate, a standard shaping procedure can be used to reinforce successive approximations, with the food reward being delivered closer and closer to the crate opening. In addition to such training activities, the dog should learn to find highly desirable treats and chew toys in or around the crate. Also, the dog can be fed with its bowl placed close to the crate and then in it. Once the dog is approaching the crate and entering, it is trained to wait briefly before being let out again. With progress, the gate of the crate can briefly closed and opened again to reward the dog's behavior (see *Guidelines for Successful Crate Training: Step 3* in Chapter 2).

Social Fears and Inhibitions

Social and environmental fears may be influenced by different emotional mechanisms and systems. The fear of others and the fear of unfamiliar objects are differentiated at an early age under the influence of socialization and habituation. Social and environmental fears appear to modulate or inhibit the expression of one another, suggesting that such fears are not under the control of a unitary substrate. For example, MacDonald (1983) found that a fear of unfamiliar objects and the fear of people are not summative; on the contrary, a reciprocal inverse relationship appears to influence their expression such that wolf pups afraid of unfamiliar objects tend to be less afraid of people, whereas wolf pups afraid of people tend to be less afraid of unfamiliar objects. These findings suggest the possibility that the fear of unfamiliar environmental events tends to promote social affiliation (excessive dependence), whereas increased social fears may tend to increase independent environmental exploration and problem-solving activities (enhanced independence).

Toward People

Dogs commonly present with varying degrees of fear toward strangers. The most common causes underlying excessive social fear and reactive behavior involve some constellation of genetic predisposition, socialization deficits, or traumatic exposure or learning. A number of techniques have proven effective in reducing social fears. Woolpy and Ginsburg (1967) have described the basic pattern of change that occurs during the treatment of excessive social fear in wolves. These stages include escape efforts, followed by avoidance, approach with aggression and, finally, friendly social interaction. It is interesting to note that, as escape and avoidance give way to approach behavior, an increased risk of aggression was observed to occur. This is consistent with the notion that fear exercises an inhibitory influence over aggression. In the case of highly aggressive animals, fear reduction may have a potential collateral effect of increasing social assertiveness.

The most beneficial techniques used for the management of social fear involve some combination of graded interactive exposure, counterconditioning, relaxation, modeling, response prevention, and play. These various procedures facilitate social contact, which serves to disconfirm aversive expectations and encourage more constructive social behavior. Deciding which procedure or combination of procedures to employ depends on the nature of the problem. Perhaps, the most common training pattern used to alter social inhibition and avoidant behavior is to train dogs to sit and accept food in the presence of people under a variety of evocative situations. As the dog's fear is reduced, closer and closer contact and interaction may be attempted. Social fears such as those directed toward visitors and other brief encounters may be facilitated by

the length of exposures being insufficient to result in relaxation. Typically, persons who are not feared by the dog are those that have spent extended time interacting with the dog during visits. Going for long walks together with an unfamiliar person (a pet walker can be hired for this purpose) can be extremely helpful. The walks must be long enough to habituate fearful responding. Once the dog is showing signs of reduced fear and increased interest in obtaining social contact (food and affection), activities like ball play can be explored as a means to extend socialization efforts. Nebuhr and associates (1977) reported a case involving an "extremely shy and withdrawn" German shepherd that was exposed to interactive play activities as the primary therapy modality. After 2 weeks of patient play therapy, the owner reported dramatic improvement in the dog's behavior, indicating that the dog had become progressively relaxed and "acted like a normal dog" (11).

The use of play in such cases should be considered only after successful exposure efforts. Of course, challenging an overly fearful/aggressive dog to play with an unfamiliar person would be dangerous and not be very productive. Dogs that are unwilling to play treat social contacts as aversive events. Another possibility is that socially inhibited dogs may lack the necessary skills and confidence needed to play. As already discussed, encouraging a fearful dog to play can promote a more trusting and open attitude toward social interaction. In the case of mild social inhibitions, play (especially in puppies) can be initiated as a starting point, but only if the risk of aggression is negligible. It should be emphasized that not all dogs that show a disinterest in play are fearful; often such dogs are unresponsive because of underlying social irritability or aggressive tensions. *Prompting such dogs to play may evoke aggression.* Dogs exhibiting social aggression with fear should be appropriately restrained with a muzzle-clamping head halter or muzzle, as needed for secure control.

Graduated counterconditioning and interactive exposure can be staged in places where high levels of foot traffic can be found. City parks can be useful for this. Relaxed exposure can take place as the owner sits on a bench with the dog on a limited-slip or halter collar, depending on need. During outdoor exposure, a hip-hitch and control lead can be extremely useful for maintaining control while freeing up the hands to deliver petting and massage, squeaks and clicks, food treats, and so forth. As passersby approach, the dog can be prompted to sit, thereby obtaining various social and tangible rewards. The delivery of noncontingent rewards (priming) or rewards delivered on a DRO schedule can be very useful. During DRO training, a brief period (e.g., every 10 to 20 seconds) is set at the end of which the dog is rewarded, provided that it does not exhibit avoidance behavior during the period. Over a number of trials, a variety of prosocial behaviors will be adventitiously reinforced. In some cases, a more sustained source of appetitive stimulation may be needed. For such purposes, a large syringe can be filled with a soft delicious food reward that is slowly dispensed to the dog in a drip, blob, or continuous squeeze, depending on need. Cheese from compressed cans can be dispensed in a similar way. Finally, a licking stick, consisting of a spoon or wooden stick slathered with peanut butter, can be a convenient way to deliver a sustained reinforcer while walking a dog. Since appetitive arousal is incompatible with fear, such a procedure can be very useful for calming a dog. Attention-control exercises can also be practiced intermittently, requiring that the dog turn and focus its attention on the trainer before the reward is delivered. Training a dog to turn its attention toward the trainer at such times gives it a potential coping strategy when confronted with fear-evoking social situations. Dogs trained in this way quickly learn to look toward the trainer for support and guidance. This procedure is especially effective if the amount and type of reward are varied and attention is paired with a conditioned reinforcer. In one variation, a novel odorant is injected into a squeaker toy (e.g., a ball) that is used as a conditioned reinforcer. As a result of repeatedly pairing the scent with food and behavioral success, eventually a very potent conditioned emotional effect is produced. Together with other conditioned stimuli, the conditioned odorant can be used to help restrain aversive emotional arousal associated

with fear-evoking situations. Dogs that exhibit a strong interest in play may be encouraged to play tug or fetch a ball while on leash in order to facilitate a more relaxed attitude in unfamiliar surroundings. Training efforts can also be carried out near stores, where exiting shoppers provide discrete and repeated trials for approach exposure. During such exposure training, the dog can be prompted to sit and stay as the shopper comes through the store exit.

Dogs that fear strangers are often very reactive around crowds. Exposure to groups of people should proceed very gradually, beginning with minimally provocative situations and only slowly advancing toward more challenging situations according to the dog's ability and tolerance. In the case of a moderate fear of crowds, a graded interactive exposure technique may be used. Intensive attention training as well as shaping of controlled walking and heeling skills can be performed. Every few steps with the dog in the controlled-walking position, the trainer clicks and delivers a variable reward. In addition, the dog should be prompted to quick-sit every so often after bridging controlled walking. In this case, instead of giving the dog a food reward, the vocal and hand sit signal are delivered, followed by "Good" and the delivery of a food reward. During an outdoor event, for example, where a large crowd is gathered, the dog may react with less fear if it is initially walked along the opposite sidewalk away from the gathering. After 15 or 20 minutes, provided the dog is not showing any overt signs of anxiety, it can be led across the street and walked along the adjoining sidewalk, but still kept away from direct contact with people. Finally, after another lengthy period of exposure, and provided that overt signs of fear are absent, the dog may accept more close contact and interaction with the fringes of the crowd, and so on. Incidentally, since walking is mildly anxiety reducing, it is helpful to keep the dog moving during such exposures.

Dogs exhibiting fears toward people should receive intensive basic training as a preliminary to graduated counterconditioning and response-prevention therapy. Most fearful dogs develop increased confidence, improved attention abilities, and enhanced control over emotional behavior as the result of daily structured training activities. Sit-stay and down-stay training using a reward-based process in conjunction with attention and orienting conditioning can be very useful to promote control and fear-antagonizing internal states linked with sitting and lying down. Also, PFR training with olfactory conditioning can be useful. Once an odorant is conditioned, it can be placed on a tissue and held in the trainer's hand or dispensed with a squeaker or modified CO_2 pump. Delivering the scent during social encounters appears to help modulate a dog's emotional arousal, perhaps making social counterconditioning efforts more effective. These various preliminary attention and basic training procedures are collectively referred to as the *counterconditioning platform*.

Toward Dogs

Learning to interact confidently with other dogs begins early in a puppy's life, especially between weeks 3 and 8. Puppies that are taken too early from their littermates and mother, or otherwise inadequately socialized, may exhibit signs of increased fearfulness around dogs as they reach maturity. Undersocialized dogs may exhibit pronounced deficits in their ability to reciprocate playful overtures initiated by other dogs. They are often unable to exchange ritualized threat and appeasement displays competently and may be particularly awkward in situations involving unfamiliar dogs. The friendly approach of another dog may evoke frantic efforts to escape or cause the overly fearful dog to freeze in a trembling ball of nerves. Typically, dogs exhibiting a socialization deficit may feel equally uncomfortable in the presence of both male and female dogs, but some may show specific aversions and preferences. In addition to socialization deficits, fear of other dogs can often be traced to traumatic experiences occurring at some point in the dog's life. Young puppies are especially prone to develop persistent fears after being attacked by an adult dog. Such experiences may be especially traumatic in cases where the event occurs in an unfamiliar location or in a location already associated with distress, e.g., a veterinary clinic or kennel.

The aforementioned procedures for managing dogs fearful of unfamiliar people are modified for controlling fear of other dogs. Socialization and training efforts should be carried out that bring the socially inhibited dog into progressively more demanding encounters with other dogs. A good controlled situation for such exposure is a veterinary clinic during office hours. Dogs entering or leaving the clinic provide discrete trials of controlled exposure. As dogs exit the clinic, the trainer can prompt the dog's attention (squeak and click), signal it to sit, and reward it ("Good") with a variable treat, first at a distance and then progressively closer to the target dog. The presence of a friendly and nonthreatening canine model can also be very helpful. Using a friendly dog model to go along on walks and to participate in training sessions may provide a framework for making more positive future contacts with other dogs. The positive model may also help the dog to overcome some of its inhibition. Once some degree of control is established, the fearful dog can be taken to group training classes for additional exposure and counterconditioning.

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4

Separation Distress and Panic

PART 1: NEUROBIOLOGY AND ONTOGENETIC INFLUENCES

The dog's ability to form satisfying attachments and bonds with people has secured for it a unique place in human society. Dogs are often treated as members of the family, with a level of care and affection that rivals the treatment reserved for children. For most people, the relationship formed with a dog is immensely gratifying. The majority of dogs appear to reciprocate our affection and invite close contact. Most dogs are adept at engaging people in prosocial relations by attracting attention to themselves by various means. In fact, much of what well-socialized dogs do appears calculated to maintain or enhance close contact with human companions. In addition to making bodily contact, various gestures, postures, vocalizations, and expressive rituals are used to communicate the dog's prosocial intention to interact and make contact with us. The preeminent means for promoting affiliative contact is play. Through our

mutual capacities to play, people and dogs seem to transcend evolutionary barriers and open a common ground of empathy and appreciation for one another.

The powerful attraction and affiliations formed between dogs and people are a source of considerable pleasure, so long as the object of affection is present and available. When left alone, all normal dogs appear to experience some degree of discomfort by separation; however, the vast majority learn to cope with routine separation without becoming overly distressed. Many, though, respond adversely to separation, exhibiting varying degrees of despair, emotional arousal, or panic. Separation-reactive dogs may engage in a variety of undesirable behaviors, including motor excesses (pacing, running about, and jumping up on counters and window sills), excessive vocalization (persistent barking and howling), various destructive activities, and separation-related elimination problems. In extreme cases, a dog appears inconsolably worried and panicked about its inability to restore contact with the absent owner. Some dogs become separation reactive as the result of being confined to a separate room while the owner is elsewhere in the house, whereas others may exhibit signs of distress (e.g., household elimination and destructiveness) as the result of being merely denied contact and attention from the owner. Aside from the potential household damage produced by such dogs and the complaints of neighbors about excessive barking, separation-related distress represents a significant welfare concern.

Separation distress in dogs presents with a variety of behavioral signs under the influence of several coactive influences, including anxiety, fear, stress, boredom, frustration, and panic (see *Separation Distress and Coactive Influences* in Volume 1, Chapter 4).

Traditionally, borrowing from human psychiatry, the term *separation anxiety* has been adopted to name the syndrome in dogs. In the author's opinion, the notion of *anxiety* at separation has led to considerable confusion with respect to understanding the etiology of separated-related behavior and its treatment. First, separation distress appears to be mediated by a neural circuit that is functionally discrete from circuits subserving anxiety and fear. Second, although some overlap certainly exists between separation distress and anxiety, overlap also exists with other coactive influences, such as boredom, frustration, stress, and panic. As a result of these considerations, the term *separation distress syndrome* (SDS) has been adopted to emphasie the multimodal function of behavior commonly referred to as separation anxiety.

NEUROBIOLOGICAL SUBSTRATES OF ATTACHMENT AND SEPARATION DISTRESS

Adaptive behavior is the outward appearance of an utterly astonishing and complex infrastructure of physiological processes. Understanding the evolutionary origins and biological significance of canine social behavior, attachment, and separation distress depends on some familiarity with neurobiology and the neural substrates mediating the expression of such behavior. Dogs, like other mammalian species, have evolved species-typical behavior patterns associated with maternal care (nursing), separation calls, and play. MacLean (1985) has implicated paleomammlian limbic pathways and diverse interconnections between the amygdala, hippocampus, septum, thalamus, hypothalamus, and cingulate cortex as providing the neurobiological substrates for the emergence of the mammalian capacity to give and receive care, to seek and enjoy company, and to interact playfully (see *Neurobiology of Attachment and Separation Distress* in Volume 1, Chapter 3).

Neuropeptides and Social Behavior

Humans and dogs exhibit a mutual need for social contact and comfort, providing a motivational basis for interspecies attraction and social bonding. Odendaal (2000) refers to our shared need for positive social interaction as emanating from an emotional capacity, *attentionis egens*, to give and receive affection and comfort from the company of one another—a capacity that is evident in social behavior as well as reflected in a variety of physiological changes that occur during such interaction (see *Tactile Stimulation and Adaptation* in Chapter 6). A diverse assortment of neuro-

chemical influences mediates social attraction and affiliative behavior. For example, phenylethylamine, a centrally active amine, is believed to promote a rapid increase in alertness, activity, and positive affect (euphoria), changes that may be involved in the biology of social attraction between people and dogs. Both people and dogs show a significant increase in phenylethylamine activity, as indicated by increased levels of circulating phenylacetic acid (a metabolite of phenylethylamine) following brief periods of positive social interaction (Odendaal and Lehman, 2000).

A variety of neuropeptides that are strategically distributed throughout the paleomammalian system serve to mediate the expression of attachment, separation distress, social comfort, and a variety of other ancient social behaviors. These neuropeptides include endogenous opioids (endorphins and enkephalins), substance P, oxytocin, prolactin, and arginine vasopressin (AVP). A number of different opioid receptors are widely distributed in the canine brain, with many concentrated in areas of the brain believed to mediate the expression of separation distress and agitated-explosive behavior (panic circuit) (Panksepp, 1982). These opioid-sensitive receptors serve a number of functions, including the modulation of physical and emotional pain, the regulation of mood, the mediation of reward and pleasure, and social attachment (see *Limbic Opioid Circuitry and the Mediation of Social Comfort and Distress* in Volume 1, Chapter 3). Opioids have been shown to modulate canine social behavior (Panksepp et al., 1983; Knowles et al., 1989) and separation-distress vocalization (Panksepp et al., 1980). Opioidergic disturbances have been implicated in the elaboration of various mood and emotional deficits associated with learned helplessness and depression (Tejedor-Real et al., 1995).

The neuropeptide substance P closely interacts with opioid pathways in various parts of the brain, but in association with opposite hedonic effects. The activation of substance P pathways is closely associated with psychological stress and the experience of emotional anguish and pain. Substance P exhibits a preferential affinity for the receptor neurokinin 1 (NK-1). NK-1 receptors are concentrated in brain areas associated with aversive emotional arousal (e.g., the amygdala, hypothalamus, and periaqueductal gray). In addition to mediating anger and rage, substance P plays a role in the transmission of peripheral pain, mediates separation distress, and facilitates the addictive effects of opiates. Murtra and colleagues (2000) have reported that NK-1 knockout mice (mice lacking the gene needed for the expression of the NK-1 receptor) are unresponsive to morphine and do not show physical withdrawal symptoms when the administration of the drug is stopped. Substance P agonists generate separation-like distress vocalizations in guinea pigs—an effect that is "virtually abolished" by pretreatment with a substance P antagonist. Substance P antagonists have been shown to suppress separation-induced distress vocalization completely in guinea pigs (Kramer et al., 1998).

Another highly influential neuropeptide that closely interacts with opioid pathways is oxytocin, perhaps co-mediating emotional changes opposite to those produced by substance P. Whereas substance P is evocative of emotional anguish, social irritability, and rage, oxytocin promotes emotional comfort, pleasure, and well-being, as well as exerting potent antiaggression effects (Panksepp, 1998). In addition to mediating such biological functions as parturient contractions and the milk let-down reflex, oxytocin is involved in the expression of maternal behavior, social bonding, and the modulation of separation distress (see *Social Comfort Seeking and Distress* in Volume 2, Chapter 4). Oxytocin has been identified as playing a significant role in early olfactory learning, especially the rapid conditioning of environmental-scent stimuli associated with the mother (Nelson and Panksepp, 1996) and place attachments. Such learning may mediate the calming effects that familiar and safe places have for dogs. Place attachments associated with the mother's odor may prevent the young from wandering too far away from the nest and the mother's protection, as well as promote huddling behavior. In contrast to the formative effects of oxytocin on place attachments, substance P and substance P agonists appear to induce strong place aversions (Kramer et al., 1998).

In addition to olfactory memories associated with place attachments, oxytocin promotes the consolidation of olfactory memories needed for social recognition (Ferguson et al., 2002). In rats, the effect of oxytocin on social recognition appears to be dose dependent, with low doses facilitating social recognition learning and high doses blocking it. Knockout mice lacking the gene necessary for the production of oxytocin exhibit various social deficits, including an inability to effectively process olfactory social stimuli and to consolidate olfactory memories of conspecifics (Ferguson et al., 2000). Interestingly, these olfactory-dependent social recognition abilities are restored by the injection of oxytocin into the medial amygdala (Winslow and Insel, 2002). Knockout mice are also more aggressive as adults than oxytocin-expressing counterparts (Winslow et al., 2000). Although not yet scientifically demonstrated to my knowledge, oxytocin probably plays a central role in mediating long-term kin recognition in dogs (see *Attachment and Separation Distress* in Volume 2, Chapter 4).

Developmental Adversity and Adjustment

Affiliative behaviors and separation-distress behaviors are grounded in both phylogenetic and ontogenetic influences. Developmental influences on dog behavior take place within the context of biological constraints and timetables that roughly serve to define a dog's potentiality—a biogenetic potential that remains unactualized in the absence of appropriate experience and organizing learning. A sensitive period for socialization occurs during a time of rapid change and development early in a puppy's life. The socialization period is characterized by an inverse relationship between waning social attraction and a gradual increase in social aversion and fear (Figure 4.1). In addition to the expression of biogenetic propensities for social contact, attachment, and aversion, acquired Pavlovian expectancies and instrumental social and motor skills gradually shape the behavioral phenotype to reflect social and environmental pressures. Each step in the process necessarily influences subsequent steps (epigenesis), with disruption occurring at any point in the process potentially exerting pervasive disturbances over subsequent developmental organization and behavior.

Learning consists of various sensory and neurobiological processes whereby information and behavior are integrated and coordinated with the ultimate goal of optimizing an animal's ability to adapt and achieve a better state of being. The ability to learn and adjust enables dogs to predict and control the social and physical environment better. However, the adaptation process is not without error, adversity, and misfortune—life is relentlessly stressful and risky. Consequently, evolution has favored the perpetuation of biobehavioral stress systems that are flexible and capable of coping under the adversities of behavioral conflict, failure, and threats (e.g., fear, anxiety, frustration, anger, and irritability). Biological stress serves to mobilize a cascade of coordinated behavioral and physiological events that improve an animal's ability to survive under adverse conditions. However, as the result of disruptive early experiences or trauma, these adaptive mechanisms may become maladaptive and potentially result in lifelong disturbances in a dog's ability to cope and respond adaptively to stressful situations, especially those stressors involving emotional adversity.

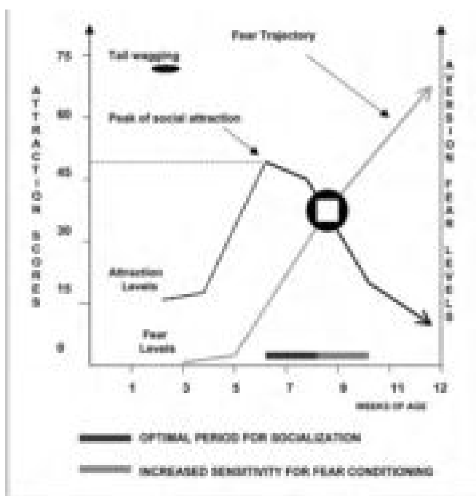


FIG. 4.1 The socialization period is associated with numerous developmental changes reflected in dramatic shifts in social attraction and fear.

During the first 16 weeks, various changes in autonomic reactivity and the propensity for social attraction and aversion follow a consistent pattern of heart-rate changes (Scott, 1958) (see *Socialization: Learning to Relate and Communicate* in Volume 1, Chapter 2). Until the onset of the socialization period, neonatal puppies exhibit a rapid heart rate before it undergoes a significant deceleration between weeks 3 and 5, possibly associated with the emergence of parasympathetic dominance—an autonomic change occurring in close association with increased social attraction and elevated thresholds for fear. After week 5, a puppy's heart rate begins to accelerate again and peaks between weeks 7 and 8, marking the emergence of sympathetic dominance. With the onset of sympathetic dominance, puppies become progressively wary about making new social contacts and begin to show increasing fear and responsiveness to aversive conditioning, especially between weeks 8 and 10. Fear thresholds continue to fall until the close of the socialization period at week 12. From weeks 7 to 16, the heart rate progressively levels out toward adult levels, representing a period of autonomic equilibrium (Figure 4.2). During periods of autonomic and developmental change, puppies may be particularly vulnerable to traumatic conditioning and stress. Early traumatic events that increase sympathetic activity may significantly impair a puppy's ability to cope with stress and aversive stimulation as an adult, making the dog either hyperresponsive (choleric/c type) or hyporesponsive (melancholic/m type) to environmental stimulation. On the other hand, insufficient stimulation may also produce a damaging effect. The key is to provide puppies with appropriate and adequate stimulation to support their developmental needs and promote adaptive adjustments consistent with sanguine (s type) and phlegmatic (p type) typologies.

Origin of Reactive versus Adaptive Coping Styles

Traumatic stress may also exert a pronounced influence on subsequent development from a much earlier age. Deprivations and excessive stress during the first 2 weeks of life may permanently disrupt the normal pattern of neural development and result in disturbances associated with coping and impulse-control deficiencies, common features of many dog behavior problems, including separation-related problems (see *Postnatal Stimulation*). Given the potent effects of early handling and gentling on stress reactivity, emotionality, and

ANS	PRIMATIVE ORGANIZATION	PARASYMPATHETIC DOMINANCE	SYMPATHETIC DOMINANCE	INTEGRATED ANS
SOCIAL	APROACH-WITHDRAWAL	INCREASING ATTRACTION LOW FEAR	DECREASING ATTRACTION INCREASING FEAR	REGULATED SOCIAL BEHAVIOR
HR	ACCELERATED	DECELERATED	ACCELERATED	LEVELING
AGE	Birth to 3 Weeks	Weeks 3 to 5	Weeks 5 to 8	Weeks 8 to 16

FIG. 4.2. Changes in heart rate (HR) are highly correlated with behavioral changes that may reflect underlying developmental changes associated with neural development and integrated autonomic activity. ANS, autonomic nervous system.

social dominance, it is reasonable to assume that unfavorable influences during the neonatal period may adversely impact separation-distress circuits [see *Neonatal Period (Birth to 12 Days)* in Volume 1, Chapter 2]. During the first 2 weeks of life, there is a transient "overproduction" and proliferation of oxytocin and AVP receptors in limbic brain areas of infant rats that gradually moves toward adult levels as rat pups mature (Tribollet et al., 1991). The adult distribution of AVP-binding sites is established by the time of weaning. These sites include areas associated with the mobilization of fear and emotional stress in adulthood [viz., the locus coeruleus, the nucleus of the solitary tract, the central amygdala, and the septal area (an area associated with separation distress)]. On the other hand, oxytocin sites are generally located in areas of the brain associated with social attachment, reward, and the behavioral approach system (viz., the cingulate cortex, the nucleus accumbens, and the caudate putamen). Oxytocin sites undergo change in distribution and density at the time of puberty, including a proliferation into brain areas associated with social recognition (the olfactory tubercle), social fearful behavior (the posterior central amygdala), and sexual and maternal behavior [the bed nucleus of the stria terminalis (BNST)]. By day 60, there is a twofold increase of oxytocin-binding sites expressed in the central amygdala and the BNST, another site believed to play a role in the elaboration of separation distress. Finally, oxytocin-binding sites in the ventromedial hypothalamus were expressed only toward the end of the 60-day period.

The changing distribution of oxytocin-binding sites suggests the possibility that similar changes might mediate developmental changes in puppy social approach and fear patterns described previously, suggesting several interesting hypotheses concerning a potential role of oxytocin and AVP in the organization of social behavior and the integration of social-emotional stress responses. The restraint of autonomic arousal and the mediation of social approach between weeks 3 and 5 may reflect heightened oxytocin activity, whereas the increasing fear and sensitivity to avoidance learning emerging as the puppy moves into week 8 and 10 may be due to emergent AVP dominance and the downregulation of oxytocin. In addition, although this is conjecture, early AVP activity may play a role in keeping puppies huddled together via a calming effect mediated by oxytocin produced in association with nursing and tactile stimulation with littermates, which, if discontinued by the puppy wandering too far away, might trigger distress signals via the activation of AVP and CRF painlike circuits, causing the puppy to seek contact with the mother and littermates to obtain relief via oxytocin release. In addition to mediating contact comfort, oxytocin appears to facilitate social recognition (Ferguson et al., 2002). The theme of comfort and safety seeking with familiars that is sketched out in early infancy may exert a profoundly influential effect over the epigenetic development of social behavior, attachment, and separation-related behavior. Accidental separation of a neonatal puppy over some lengthy period might result in significant sensitization of separation-distress circuits, perhaps predisposing the puppy to a heightened sensitivity to separation in adulthood. Inadvertent exposure to excessive stress or trauma in early puppyhood may play a key etiological role in the development of a variety of social and stress-related behavior problems (e.g., separation panic and owner-directed aggression).

Early epigenetic approach-withdrawal adjustments foreshadow the elaboration of increasingly sophisticated social recognition abilities, comfort- and safety-seeking behaviors, emotional complexity, and cognitive abilities that gradually unfold and enable dogs to form prediction-control expectancies and social relationships. The development of these abilities enables dogs to learn and to adapt by means of optimized control modules, modal strategies, and choice (see *Ontogeny and Reactive Behavior* in Chapter 8). As such, learning enhances a dog's ability to control social and environmental events, thereby increasing its competence and well-being, whereas a failure to learn from experience promotes incompetence, distress, and reactive behavior. The process of adaptive learning appears to be intimately linked to oxytocin and dopamine reward circuits. When eating food, dogs exhibit a rapid, steep, and extremely brief spike of oxytocin release (Uvnäs-Moberg et

al., 1985). The oxytocin spike associated with eating is sensitive to conditioning, with dogs responding to conditioned stimuli that regularly occur in advance of the presentation of food. Whereas oxytocin appears to mediate reward associated with gratification, comfort, and safety, dopamine appears to mediate reward associated with surprise, heightened arousal, and increased incentive (Schultz, 1998). These differential reward effects produced by oxytocin and dopamine point to an important function of cynopraxic training and therapy, to wit: the mediation of an antistress response via physiological and neurobiological changes conducive to social attachment and bonding. However, in addition to mobilizing an antistress response, oxytocin exerts potent anti-aggression and antifear effects while promoting social approach, affectionate interaction, and calming. Consequently, in addition to shaping and modifying behavior, petting and food rewards appear to mediate numerous additive counterconditioning and socialization benefits via the conditioned and unconditioned release of oxytocin and other neuropeptides conducive to an adaptive coping style.

Although the significance of these changes in the distribution of oxytocin-binding and AVP-binding sites remains conjectural, various suggestions have been put forth, including a role in brain growth and neural elaboration, which facilitates the formation of infant-mother attachments and the modulation of separation-related behavior. In addition to developmental changes, stressful environmental influences appear to exert pronounced effects on neuropeptide-receptor density and activity. For example, the number of oxytocin-receptor sites in the hippocampus is transiently decreased in infant rats by brief repeated exposure to maternal separation (Noonan et al., 1994).

> It is interesting to speculate that even brief separations of the infant from the mother, manipulation that involves both stressing the infant and the disruption of a social bond, may have effects on oxytocinergic activity that subsequently influence the expression of social- or stress-related behaviors or endocrine function. (119)

The developmental effects of comfort- and stress-induced alterations in oxytocin-receptor proliferation has been shown to exert profound changes in adult social and maternal behavior (see *Antistress Neurobiology, Maternal Care, and Coping Style* in Chapter 8).

Stress and Flight or Fight Reactions

The close association of AVP with areas of the brain associated with the activation of emotional stress, fear, and aggression (see *Arginine Vasopressin and Aggression* in Volume 1, Chapter 3) suggests the possibility that AVP may play a significant role in the mediation of a reactive stress response, whereas oxytocin appears to mobilize an adaptive or antistress response conducive to cooperative interaction and bonding (Uvnäs-Moberg, 1997b). The finding that the central amygdala expresses both oxytocin-binding and AVP-binding sites is intriguing with respect to this general hypothesis and the notion that these neuropeptides may mediate opposite effects on the elaboration of emotional stress responses and social adjustment. Whereas oxytocin appears to activate systems conducive to what might be called an adaptive *flirt and forbear* response (see *Adaptive Coping Styles: Play, Flirt, Forbear, and Nip* in Chapter 6), AVP appears to mediate a reactive flight or fight response (social avoidance, punishment, and agitation), perhaps via epigenetic interaction with corticotropin-releasing factor (CRF), testosterone (see *Arginine Vasopressin, Testosterone, and Serotonin* in Chapter 6), and substance P.

CRF, oxytocin, and AVP are all produced by the paraventricular nucleus (PVN) of the hypothalamus. The release of CRF by the PVN activates the hypothalamic-pituitary-adrenal (HPA) system by prompting the anterior pituitary gland to release adrenocorticotropic hormone (ATCH), which, in turn, causes the adrenal cortex to secrete glucocorticoid hormones (cortisol and corticosterone) into the bloodstream (see *Startle and Fear Circuits* in Chapter 3). Circulating glucocorticoids exert a negative-feedback effect on the hypothalamic stress response. CRF-containing neurons located in the central amygdala initiate the emotional stress response via projections to the locus coeruleus and the release of

norepinephrine (NE), which in turn mediates the rapid release of epinephrine by the adrenal medulla and the activation of the sympathetic nervous system. These amygdala CRF neurons show a threshold shift and potentiation in response to repeated and uncontrolled emotional stressors, possibly resulting in generalized anticipatory anxiety (Cook, 2002) (see *Stress-related Potentiation of the Flight-Fight System* in Chapter 6).

The amygdala mediates the hypothalamic stress response by means of a direct pathway via the BNST and an indirect pathway via medullary NE-producing neurons—the primary signal activating CRF production and release. The medial prefrontal cortex forms reciprocal connections with the amygdala, as well as projecting to every major system involved in the mobilization of the stress response. These various prefrontal and subcortical interactions mediate the process of organizing adaptive control expectancies and emotional establishing operations. Increased catecholamine activity associated with acute stressors enhances attention and alertness to environmental stimuli, but with a cost to cognitive functions. Increased dopamine (DA) activity under the influence of stress may reduce prefrontal efficiency, perhaps in vulnerable dogs, significantly disrupting their capacity to perform executive control functions (see *Stress-related Influences on Cortical Functions* in Volume 1, Chapter 3). In human subjects, high cortisol levels in response to moderate stressors are associated with decreased problem-solving capacity, increased arousal and focus on sensory stimuli, and negative mood (e.g., depression, anxiety, and confusion) (Al'Absi et al., 2002).

As a result of an intense threatening event or loss of control (e.g., abusive punishment), NE is rapidly released in the prefrontal cortex and the central amygdala, coordinating a shift from behavior organized in accordance with expectancies and calibrated establishing operations to one of heightened arousal and vigilance, mobilizing the flight-fight system in preparation to escape or attack, if necessary, to secure safety. Under such circumstances, behavioral output may become highly reactive and unpredictable, especially in cases involving a history of abusive treatment. Glucocorticoid negative feedback helps to reverse stress-related arousal by turning off the release of ATCH and by generally quieting the flight-fight system by inhibiting CRF and NE activity while increasing mesocortical DA activity and facilitating serotonin (5-hydroxytryptamine or 5-HT) stress-management functions. Chronic stress, however, appears to gradually exert a global dysregulatory effect on prefrontal and central amygdala functions, while circulating glucocorticoids may slowly degrade the functional fitness of hippocampus (see *Hippocampal and Higher Cortical Influences* in Volume 1, Chapter 3). Chronic stress can be extremely harmful to the integrity of the brain's stress-management system and the dog's ability to adjust adaptively, producing widespread disturbances and dysregulation of DA, 5-HT, and NE systems (see *Startle and Fear Circuits* in Chapter 3). Finally, in addition to playing a central role in the mediation of behavioral stress and anticipatory anxiety, CRF produces a suppressive effect over appetite and facilitates the expression of separation-related distress (Panksepp et al., 1988).

Maternal Separation and Stress

Excessive stress early in a dog's life cycle may disrupt critical neurobiological checks and balances associated with glucocorticoid- and CRF-receptor proliferation and sensitivity, making the puppy more vulnerable to the adverse effects of uncontrollable environmental and social stressors in adulthood. Heim and Nemeroff (1999) have argued that early abuse and emotional trauma in childhood may predispose people to develop a variety of stress-related psychiatric conditions later in life, pointing to CRF sensitization and HPA-system dysregulation as decisive etiological factors. Central CRF activity in the limbic system and brainstem appears to mediate anxiety and other mood disturbances. As the result of early sensitization of the CRF system, even moderate levels of stress may produce significant perturbation of emotional and cognitive functions in adult animals. Early exposure to adverse maternal separation appears to sensitize the HPA system, causing isolation-stressed rats to produce excessive ACTH and adrenal cor-

ticosterone when exposed to psychological stress as adults.

A laboratory model for studying the effects of neonatal handling on adult stress and psychopathology has been developed in rats. Maternal separation can either improve or disturb adult coping abilities, depending on the sort of isolation used. Although brief periods of stressful handling early in life appear to have a highly beneficial effect on an adult animal's ability to cope with stress (Levine et al., 1967), more lengthy exposure to repeated stressful separation from the mother may result in increased sensitivity and vulnerability to stress as an animal matures. The perturbations appear to involve changes in the brain's responsiveness to stressful stimuli, especially central CRF-mediated activation. Plotsky and Meaney (1993), for example, reported that infant rats, when repeatedly separated from their mothers on days 2 to 14 for 180 minutes, exhibit pronounced and persistent changes in the density of CRF-receptor-binding sites and increased CRF-system activity, whereas animals exposed to briefer separation experiences (15 minutes) showed an opposite effect, exhibiting significantly less CRF-system activity than both the 180-minute separation group and the control group that had been left undisturbed during the same period. Ladd and colleagues (1996) found that infant rats deprived of maternal contact for 6 hours on days 2 to 20 exhibited a 59% increase in CRF-receptor-binding sites in the dorsal raphe nucleus, the area involved in the production of 5-HT.

CRF exerts an inhibitory effect on 5-HT production (Kirby et al., 2000)—an effect that may be significantly enhanced as the result of excessive postnatal stress. CRF proliferation in the dorsal raphe nucleus and stress-induced suppression of 5-HT production may play a significant role in the etiology of stress-related dog behavior problems. Reportedly, long-term treatment with paroxetine, a selective serotonin (5-HT) reuptake inhibitor (SSRI), attenuates or reverses the neuroendocrine and HPA-system aberrations produced by stressful maternal separation, normalizing both behavioral and endocrine aspects of the stress syndrome in rats (Ladd et al., 2000). The normalizing effects of SSRIs on the brain's stress-management system may help to explain the therapeutic effects of such medications on stress-related behavior problems. Finally, the effectiveness of SSRIs and tricyclic antidepressants for controlling symptoms of separation distress in dogs suggests a close modulatory role of 5-HT within emotional circuits mediating social behavior and affiliation (Insel and Winslow, 1998).

The loss of familiar attachment objects and places produces significant stress in dogs. Hennessy and colleagues (1997) found that dogs entering a shelter initially exhibit increased levels of cortisol for several days, after which they progressively adapt toward control levels exhibited by dogs living in homes (Figure 4.3). Although separation from an attachment object is often associated with increased glucocorticoid output in adult animals, not all animals show signs of biological stress when they are separated from affiliative partners (Hennessy, 1997). Hennessy suggests that the sudden loss of an attachment object represents a major threat to animals, and the increase in HPA activity may provide the necessary biochemical and metabolic activation to cope with the threats associated with loss and isolation. Perhaps the most important factor determining whether an animal shows signs of stress at separation appears to be the degree of attachment or bonding between the separated animal and the affiliative partner. Dogs separated in an unfamiliar place exhibited increased glucocorticoid activity that was only slightly affected by the presence of a kennelmate (Tuber et al., 1996) (Figure 4.4). Interestingly, though, glucocorticoid levels of separated dogs in the presence of a familiar person, a caretaker who had worked with the dogs for many years, were significantly lower (see *Biological Stress and Separation Distress* in Volume 2, Chapter 4). The differential response of separated dogs to the presence of a familiar dog versus familiar person is difficult to explain. Ostensibly, the separated dog obtains more comfort from the presence of a caretaker than it does from its kennelmate. Precisely why this is so remains unknown, but one possible explanation is that humans represent a supernormal stimulus for social attraction and attachment (see *Supernormal*

Attachment Hypothesis in Volume 2, Chapter 4). Gantt (1944) found that the conditioned anxiety of a dog was markedly reduced by petting but not by the presence of a nearby dog. Perhaps, as the result of selective breeding for traits conducive to companionship with people, dogs may have acquired a genetically influenced preference for contact with people over contact with conspecifics (Feddersen-Petersen, 1994). Odendaal (1999) has reported that interaction between familiar owner-dog dyads results in significantly more oxytocin release than when the dog is exposed to an unfamiliar person, perhaps pointing to a neurobiological basis for the apparent preference of dogs for familiar humans. These physiological differences associated with contact-induced oxytocin activity probably reflect the effects of social conditioning on the mechanisms involved in the release of oxytocin. In any case, puppies exhibit a preference for human contact over canine contact from an early age. Pettijohn and colleagues (1977) found that puppies separated in a strange situation showed a significant reduction in separation distress when in the company of a person. Whether involving active or passive contact, the proximity of a human was more comforting to the puppy than the presence of its own mother. Surprisingly, the presence of the mother was no more effective at assuaging separation distress in a strange situation than was the presence of an unfamiliar adult dog (see *Social Attachment and Separation* in Volume 1, Chapter 2). As a social stimulus, the human being may be a better activator of oxytocin activity in dogs that show a preference for humans over other dogs—a hypothesis that would be easy to test. According to Panksepp (1992), in the context of maternal care, oxytocin may centrally stimulate emotions conducive to social approach and contact:

> A straightforward emotional prediction is that brain oxytocin may evoke warm positive feelings of social strength and comfort when aroused by peripheral stimuli. For instance, as mother and infant share in the nursing experience, brain oxytocin systems may be activated in both individuals through reciprocal somatosensory and gustatory stimulation. This would contribute to a sense of ease and relax-

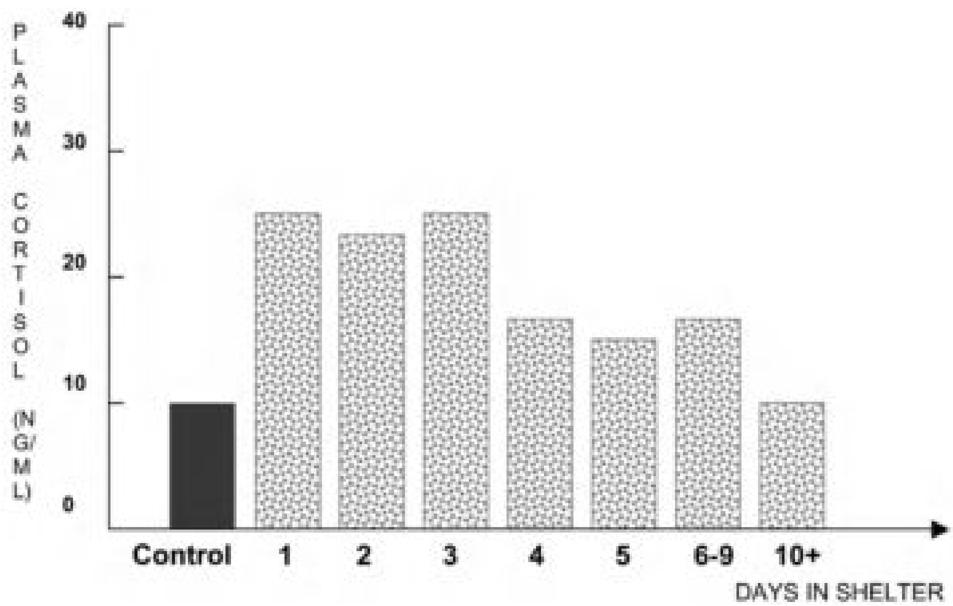


FIG. 4.3. Upon entering a shelter, dogs show a significant increase of HPA (hypothalamic-pituitary-adrenal)-axis activity. The first 3 days appear to be particularly stressful. After day 10, however, most dogs appear to be physiologically adapted to the new situation. After Hennessy et al. (1997).

> ation (feelings of acceptance and nurturance) and thereby tend to promote conditional attraction (i.e., social bonding/imprinting) between caregivers and receivers. These are the types of neuroaffective changes that would also tend to counteract feelings of isolation and distress. (243–244)

In conjunction with endogenous opioids, oxytocin performs various neuroregulatory roles in the process of modulating stress responses and coordinating dynamic neurobiological changes conducive to social bonding and the development of complex social behavior (see *Oxytocin-opioidergic Hypothesis* in Chapter 6). Like endogenous opioids, oxytocin also exerts a significant inhibitory effect over separation-distress vocalizations.

PHARMACOLOGICAL CONTROL OF SEPARATION DISTRESS

Since the cascade of events leading to full-blown separation-related panic includes the activation of the brain CRF system, drugs capable of blocking CRF-receptor sites or restraining CRF activity would probably prove beneficial in the management of separation-related problems. In addition to SSRIs, such as paroxetine, tricyclic antidepressants appear to provide such regulatory enhancement. Imipramine, for example, appears to exert a pronounced effect on CRF activity (Sternberg and Gold, 1997):

> In rats, regular, but not acute, administration of the tricyclic antidepressant imipramine significantly lowers the levels of CRH [corticotropin-releasing hormone] precursors in the hypothalamus. Imipramine given for two months to healthy persons with normal cortisol levels causes gradual and sustained decrease in CRH secretion and other HPA-axis functions, indicating that down-regulation of important components of the stress response is an intrinsic effect of imipramine. (13)

Given the complementary roles of CRF as a trigger for separation reactions and the efficacy of oxytocin to quiet them, Panksepp (1998) has suggested that medications capable of restraining central CRF activity while enhancing oxytocin activity might prove

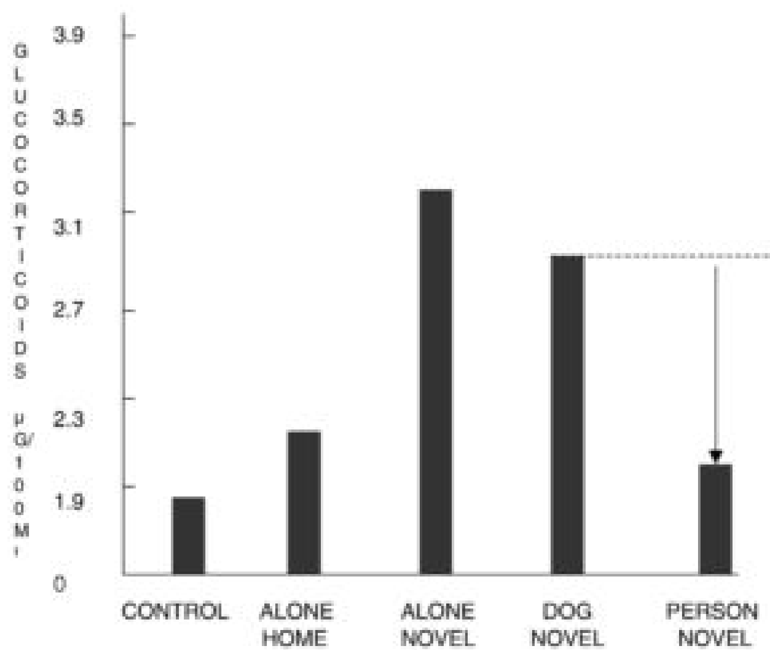


FIG. 4.4. Stress response to social contact and separation in novel and home environments. Note the increased effect of a person on a dog in a novel environment versus the effect of a familiar dog. Maximum distress occurs when the dog is left alone in an unfamiliar environment. Adapted from Tuber et al. (1996).

efficacious in the treatment of separation-related problems. Recently, promising strides have been made in the development of CRF receptor (subtype 1) antagonists (Gilligan et al., 2000; He et al., 2000). These compounds appear to have excellent oral availability, potent anxiolytic efficacy, and minimal side effects. Similarly promising advances have been made in the development of an orally available substance P antagonist (MK-869), a compound that appears to be highly effective in the management of depression and may eventually prove beneficial in the management of separation-related problems (Kramer et al., 1998). Medications with the capacity to block CRF and substance P activity offer exciting possibilities for the treatment of stress-related dog behavior problems and deserve preclinical and clinical veterinary investigation.

The preponderance of evidence supports the view that different emotional circuits mediate the expression of separation distress (panic system) and anxiety (fear system) involving the cingulate gyrus, the preoptic and ventral septal areas, the dorsomedial thalamus, the BNST, and the PAG (Panksepp et al., 1985; Panksepp, 1998). Although panic and fear systems appear to exert a reciprocal excitatory influence on one another, they are motivationally distinct systems (see *Emotional Command Systems and Drive Theory* in Chapter 6). However, certain fears, such as thunderstorm phobias, are highly correlated with separation distress (Overall et al., 2001), suggesting the possibility that the sensitization of the fear system (e.g., the occurrence of a severe thunderstorm) occurring at times when the owner—the dog's source of safety—is absent may play a role in the etiology of SDS. Many separation-reactive dogs do not show evidence of noise or thunderstorm phobias, consistent with the notion that SDS is complex in origin and affected by several causes and contributing influences. Despite the reciprocal excitatory influences exerted by fear on panic and by panic on fear, separation distress and the panic circuits mediating its expression operate with significant independence from anxiety and fear—an observation supported by both psychobiological (Panksepp, 1998) and pharmacological studies. For example, Scott and colleagues (1973) found that separation-distress vocalization in beagle puppies was not ameliorated by anxiolytic medications (e.g., chlorpromazine, reserpine, meprobamate, and diazepam), but was rapidly and consistently reduced by imipramine:

> In sufficient doses, it [imipramine] will reduce vocalization to essentially zero without producing abnormal behavior or adverse physiological side effects. Even under the largest doses, the dogs that received imipramine appeared to be no different from the controls that were given placebos, except for their vocalization rates. (17)

Imipramine produced both immediate and sustained relief from separation distress. Even though diazepam had no discernible effect on separation-distress vocalizations, treated puppies appeared to be more relaxed when handled. In the case of infant rhesus monkeys, however, diazepam has been demonstrated to produce a potent attenuating effect on separation-related stress (Kalin et al., 1987), suggesting the possibility that different aspects of the separation stress response are under the control of different regulatory neurotransmitter systems in dogs and monkeys.

Although imipramine was highly effective in controlling the separation-induced vocalizations produced by beagles and Australian terrier-beagle crosses, the drug did not control the separation-distress vocalizations exhibited by shelties and Telomians. These findings suggest that the effects of tricyclic antidepressants on SDS may be highly variable depending on the breed and temperament of dog. Observing that such drugs exert variable behavioral effects on dogs depending on breed type should not be surprising, however. Arons and Shoemaker (1992), for example, found that dogs of different breeds (e.g., Border collies, shar planinetz, and Siberian huskies) exhibit significant neurobiological variability with respect to neurotransmitter levels localized in different brain areas, as well as exhibiting differences in the expression of highly influential receptor sites (Niimi et al., 1999). These fundamental differences exert profound influences on behavioral thresholds and the dog's response to medication. Evidence of breed-related variability at the level of neural organi-

zation underscores the importance of medicating dogs according to breed-specific differences, recognizing that they are not all cut from the same neurobiological cloth.

Panksepp and colleagues (1978) found that pronounced alleviation of separation distress could be achieved in puppies with the administration of very low doses of morphine. Medicated puppies behaved normally, without signs of sedation, except that they appeared comfortable and calm while separated from mother and littermates. The benefit of morphine, however, is dose dependent, with larger doses resulting in catalepsy or, paradoxically, more separation-distress vocalization. Morphine has also been shown to control separation-distress vocalization effectively in infant rhesus monkeys, without reducing activity levels (Kalin et al., 1987). The efficacy of morphine and other opiates is dramatic, but the clinical feasibility of such medications for the treatment of SDS is limited because of the potential for abuse, rapid tolerance, and eventual withdrawal symptoms that might worsen the symptoms of SDS when the treatment is discontinued. Nonetheless, morphine in low doses (perhaps in combination with imipramine) may have a therapeutic application in the management of acute separation-related panic, especially in cases where other medications have failed.

Voith and Borchelt (1996) have suggested that a wide variety of drugs (including benzodiazepines, neuroleptics, progestins, and tricyclic antidepressants) may have some usefulness in the treatment of separation distress. Historically, the tricyclic antidepressant amitriptyline has been the most commonly prescribed medication for the control of problematic separation-related behavior. A possible added benefit of amitriptyline is a sedative effect, probably stemming from a potent blocking effect on histamines. Amitriptyline exerts a ninefold greater blocking effect on histamines than does imipramine (Julian, 1995). Benzodiazepines (e.g., clorazepate or alprazolam) are often used in combination with tricyclic antidepressants or SSRIs to enhance effectiveness, especially in cases where SDS presents comorbidly with a phobia associated with being left alone or a high level of anticipatory anxiety associated with departures. Neuroleptic medications, such as acepromazine, are occasionally used to suppress temporarily the motor expressions of acute separation distress, but they have very limited value with respect to targeting the underlying emotional arousal pathways triggering with separation distress and are generally reserved for emergencies.

More recently, the tricyclic antidepressant clomipramine, a potent 5-HT-reuptake inhibitor, has become increasingly popular for the treatment of separation-distress problems. Although clomipramine has shown promise for the management of separation-related behavior (Simpson, 1997), Podberscek and colleagues (1999) have questioned its value in the treatment of separation anxiety. In their study, the efficacy of clomipramine was evaluated as an adjunct to behavior therapy. Although clomipramine appeared to produce a significant sedative effect, it was not "any more effective than a placebo as an adjunct to behavioural therapy in the treatment of separation-related behaviour problems in dogs" (369). Hewson (2000) has criticized their study and Simpson's previous report, concluding that neither behavior therapy nor clomipramine alone or both together have been shown to control separation-related behavior problems effectively. A subsequent study, however, reported by King and colleagues (2000) indicates that clomipramine in combination with behavior therapy does significantly reduce separation-related destructiveness and elimination problems, though the combination does not significantly attenuate separation-related vocalization excesses. They suggest that the previous failure of Podberscek and colleagues to detect a reliable effect of clomipramine was due to shortcomings in the study's design (e.g., sample size).

Panksepp (personal communication, 1996) has suggested that clonidine in combination with morphine, imipramine, or a 5-HT-reuptake inhibitor (e.g., clomipramine) *might* be beneficial in the treatment of separation-related distress in dogs. Clonidine is an NE-receptor agonist that exerts mixed excitatory (postsynaptic) and inhibitory (presynaptic) effects on NE activity (Panksepp, 1998). Evidence for a beneficial role of clonidine in combination with imipramine for the control

of separation distress has been reported in squirrel monkeys (Harris and Newman, 1987); in rhesus monkeys, however, clonidine alone reduced activity levels, but without influencing separation-distress vocalizations (Kalin et al., 1988). Interestingly, clonidine in combination with passionflower (*Passiflora incarnata*) has been shown to exert a significantly superior effect over clonidine alone in the management of mental symptoms associated with opiate withdrawal (Akhondzadeh et al., 2001). An SSRI that may offer significant efficacy in the control of SDS with panic is paroxetine, which appears to influence the CRF system beneficially as well as enhance serotonergic activity, with proven efficacy in the control of human panic disorder, general anxiety disorder, and obsessive-compulsive disorder (Ballenger, 1999).

Lastly, some owners have reported success using over-the-counter drugs such as melatonin, which has been shown to modulate separation distress in chicks (Nelson et al., 1994), separation anxiety exhibited by a bear that failed to hibernate (Uchida et al., 1998), and fear of noises (Aronson, 1999). Dodman (1999) has used melatonin with some apparent success in the treatment of compulsive licking and thunderstorm phobias. Melatonin appears to modulate endogenous opioid activity, perhaps providing an opioid-mediated regulatory influence on attachment processes and separation-related distress. A bidirectional feedback relationship appears to exist between melatonin and endogenous opioids, with melatonin inhibiting opioid activity and opioids stimulating melatonin activity (Barrett et al., 2000). These findings suggest that the putative effects of melatonin on separation distress may not be mediated directly by an increase in opioid activity, but via an indirect influence existing at another level of interaction between melatonin and opioids. In rats, melatonin has been shown to attenuate the adrenocortical response to stress, to increase HPA-axis responsiveness to glucocorticoid feedback effects, and may ameliorate stress-related disturbances associated with chronic stress (Konakchieva et al., 1997). Melatonin also appears to perform a protective neuroregulatory role over the immunosuppressive effects of stress by various means (Pierpaoli and Maestroni, 1987). Finally, Pacchierotti and colleagues (2001) have conjectured that stressed animals may produce increased amounts of melatonin in an effort to stabilize internal states associated with anxiety and agitation.

Some experimental evidence indicates that melatonin may exert an inhibitory effect over thyroid activity in various animal species (Wright et al., 2000). To my knowledge, the thyroid-inhibiting effects of melatonin have not been explicitly demonstrated in dogs, but the existence of such a potential side effect warrants careful use of melatonin in the case of dogs showing borderline thyroid levels or behavioral conditions believed to be under the influence of thyroid insufficiency. Aronson (1998) has suggested that thyroid insufficiency may play a significant role in the etiology of a wide variety of behavior problems and has been associated with aggression in dogs (Fatjó et al., 2002) (see *Assessment and Identification* in Volume 2, Chapter 8). In addition, recent research shows that thyroid hormones produce an augmentative effect over cognitive functions via the enhancement of cholinergic activity, emphasizing the far-reaching influence of the hormone (Smith et al., 2002). The short-term and long-term side effects of melatonin therapy in dogs are unknown. In people, melatonin appears to be well tolerated, and the risk of toxicity is low at prescribed dosages (De Lourdes et al., 2000).

Note: The foregoing information is provided for educational purposes only. If considering the use of medications to control or manage a behavior problem, the reader should consult with a veterinarian familiar with the use of drugs for such purposes in order to obtain diagnostic criteria, specific dosages, and medical advice concerning potential adverse side effects and interactions with other drugs.

POTENTIAL ALTERNATIVE TREATMENTS

Herbal Preparations

Numerous studies (especially in Germany) have investigated the efficacy of St. John's wort, *Hypericum perforatum*, for the manage-

ment of mild to moderate depression in people (Josey and Tackett, 1999). Hypericum (0.3% hypericin) has been shown to perform on a par with imipramine, amitriptyline, and fluoxetine for the treatment of depression (Bergmann et al., 1993; Vorbach et al., 1994; Harrer et al., 1999), strongly suggesting that it may have some therapeutic value for the management of SDS and other behavior problems treated successfully with SSRIs and tricyclic antidepressant medications (e.g., compulsive excesses). Pharmacological studies in rodents indicate that hypericum extracts influence dopaminergic, serotonergic, and noradrenergic reuptake mechanisms (Mueller and Rossol, 1994; Muller and Schafer, 1996; Kaehler et al., 1999). St. John's wort has been shown to increase DA and 5-HT metabolite levels, but without affecting monoamine oxidase activity, suggesting the possibility that the herb exerts its pharmacological effects by inhibiting DA or 5-HT reuptake (Serdarevic et al., 2001). Steger (1985) found that a combination of hypericum and valerium proved more effective for the control of depressive symptoms than did desipramine, a tricyclic antidepressant having pronounced noradrenergic reuptake effects. The combination of the two herbal preparations appears to produce a synergistic effect. So far, the side effects of hypericum have been repeatedly described as minimal when the herb is taken at recommended dosages, but no studies to my knowledge have been performed demonstrating efficacy or safety with dogs. The ingestion of large amounts of St. John's wort may cause gastric disturbances or phototoxicity. Although several studies have indicated that St. John's wort is an effective treatment for mild depression, Davidson and colleagues (2002) failed to detect a therapeutic benefit resulting from hypericum treatment for moderately severe-major depression in human patients. Among the patients studied, hypericum was no more effective than its matched placebo. Interestingly, however, sertraline, a potent SSRI commonly used to treat depression, failed to perform much better than hypericum in terms of primary outcome measures, leaving some questions open for future study. Finally, Fornal and colleagues (2001) have directly measured the discharge rate of 5-HT neurons in the dorsal raphe nucleus after administering St. John's wort to awake cats. They found that St. John's wort had no effect on neuronal activity, in sharp contrast to the robust effects produced by fluoxetine and sertraline. Both SSRIs produced a marked reduction of neuronal activity by increasing synaptic 5-HT levels. These findings suggest that the putative effect of St. John's wort may be mediated by a mechanism other than 5-HT-reuptake inhibition.

Two other herbal preparations that may exert some modulatory control over the distress associated with separation are ginkgo biloba and kava kava. Porsolt and colleagues (1990) reported that preventive dosing with ginkgo biloba prior to repeated inescapable shocks produced a significant protective influence against stress associated with learned helplessness. The blocking effects of ginkgo biloba against symptoms of learned helplessness were more robust than the effects produced by diazepam and did not impair passive avoidance learning—a side effect observed to occur in association with benzodiazepines. Finally, some evidence suggests that kava extract may modulate circuits controlling separation distress. Many double-blind, randomized, and placebo-controlled trials have demonstrated the efficacy of Kava extracts (30% kavalactones) for the symptomatic treatment of anxiety (Pittler and Ernst, 2000). Kava extracts have also been shown to attenuate separation-distress vocalizations and stress-induced analgesia in 8-day-old chicks (Smith et al., 2001). Whether similar effects might occur in dogs is not known. Scattered reports associating the use of kava kava with severe side effects, including liver damage, have recently called the safety of herb into question. Although serious side effects do appear to occur sporadically, they appear to be relatively rare when kava kava is taken without other drugs for short periods at recommended dosages (Stevinson et al., 2002). The potential benefits and side effects of kava kava for the management of separation-related problems in dogs is unknown; nonetheless, it is widely used, alone or in combination with St. John's wort, by dog owners seeking an over-the-counter cure for separation-related stress, often without veterinary guidance and support.

Herbal preparations that are capable of producing a clinical benefit should be considered prima facie capable of producing harmful side effects if improperly used. In addition, herbal remedies may interact synergistically with other medications in ways that could be potentially harmful to a dog, requiring that such remedies be carefully evaluated for safety before considering their use (Cooper, 2002). Consequently, like other medications used in the control and management of behavior problems, complementary herbal and dietary regimens should be introduced under the close supervision of a veterinarian familiar with the various clinical effects and side effects of such treatment programs.

Dog-appeasing Pheromone

A synthetic analogue of apaisine, a pheromone reportedly produced by lactating female dogs, may exert a beneficial modulatory effect over separation distress. The putative pheromone is believed to produce a calming effect on nursing puppies. Unfortunately, the basic scientific evidence supporting these potentially exciting and breakthrough findings remains to be published. To the best of my knowledge, the procedures used to isolate and synthesize the pheromone, its biochemical characteristics and molecular description, and evidence in support of its putative emotional and behavioral effects on puppies and adult dogs have not yet been published in a peer-reviewed scientific journal. Pheromones are captured by the vomeronasal organ and processed by the accessory olfactory bulb. Although dogs lack a true flehmen response, they do exhibit tonguing—a flehmenlike response that appears to collect pheromone molecules from the air and surfaces where they have been deposited (see *Vomeronasal Organ* in Volume 1, Chapter 4). Preliminary results of a multicenter study are promising, showing that the synthetic analogue, marketed as dog-appeasing pheromone (DAP), may produce a clinical effect comparable to clomipramine when used in combination with behavior therapy to treat separation-related behavior problems (Gaultier and Pageat, 2002). Curiously, though, given the robust release of oxytocin and prolactin during nursing (Uvnäs-Moberg et al., 1985), it seems odd that a functionally redundant pheromone would also be genetically coded to produce an appeasing effect in support of an activity that is intrinsically calming for a puppy to perform in the first place. A plug-in electric diffuser supplied with the product dispenses DAP into the air. In addition to possibly helping to calm separation-reactive dogs, DAP is believed to reduce stress and fear. Another proposed use of DAP is to facilitate a puppy's transition into the home or ease the acceptance of stressful environmental changes (e.g., moving). Perhaps the appeasing pheromone can be harvested by wiping the intermammary line of lactating females with gauze moistened with dilute alcohol. The collected material can then be mixed with water and dispensed from a spray bottle or other means (e.g., placed on toys). Also, sending home towels and bedding containing the odors of the mother may help to facilitate the puppy's transition into the new home. In any case, pheromone or not, maternal odors may produce beneficial emotional effects by means of conditioned associations.

Note: The foregoing information is provided for educational purposes only. If considering the use of herbal remedies, the reader should consult with a veterinarian familiar with the use of such preparations to obtain specific dosages, diagnostic criterion for their use, and medical advice regarding potential side effects.

SEPARATION DISTRESS AND DIET

In the past, dog owners were frequently advised to make various dietary changes for the purpose of altering a dog's behavior or motivation. Most of these recommendations have come and gone, leaving in the wake a high degree of skepticism about the usefulness of dietary manipulations for the management of behavior problems. Undoubtedly, the quality, quantity, and combination of foods eaten by a dog exert some influence, but the extent of these influences and the specifics involved remain to be disclosed by animal psychodietetic research (Ballarini,

1989). What little is known, however, may be useful for managing some problems associated with separation distress, anxiety, and panic. For example, the physiological arousal and aversive motivational tensions associated with hunger may increase exploratory and destructive activities when a dog is left alone. A full stomach may help dogs to relax and sleep when alone. Consequently, it may be useful to feed separation-reactive dogs in the morning rather than in the evening. In addition to morning feedings, Mugford (1987) suggests that a high-fiber diet may help to calm separation-reactive dogs and reduce destructiveness, but provides little evidence to support this claim. Growing evidence suggests that essential fatty acids (EFAs), especially omega-3 fatty acids (fish oils), may alter negative mood and alleviate depression (see *Aggression and Diet* in Chapter 7). In addition, some evidence suggests that olive oil may also exert some benefit on mood (Puri and Richardson, 2000). Olive oil is a rich source of oleic acid, the nutritional precursor of oleamide, a psychoactive lipid. Oleamide appears to play a significant role in sleep induction and the modulation of serotonergic neurotransmission (Huidobro-Toro and Harris, 1996; Thomas et al., 1998). The anxiolytic effects of diets rich in soy may be beneficial in some cases of SDS presenting comorbidly with anxiety and fear (Lephart et al., 2002). Although dietary change and supplementation may provide a nutritional benefit for the management of separation-related problems, the efficacy of such nutritional supplementation for the management of SDS remains to be clinically evaluated and should be considered on a case-by-case basis under the advisement of a veterinarian.

Various preservatives, additives, flavorings, and dyes used in the manufacture of dog food have been suspected of producing a wide variety of effects on behavior, but no solid evidence is yet available to support the widely held conviction (Halliwell, 1992). A common source of allergies among dogs is food, suggesting that certain foods might produce neurotropic allergies that could contribute to the development of behavior problems, including SDS. Excessive sugar in the diet has been frequently pointed to as a cause of hyperactivity in children, but no solid scientific evidence supports the hypothesis (see *Dietary Factors and Hyperactivity* in Volume 2, Chapter 5).

One isolated report has suggested that diet plays a dramatically significant role in the treatment of behavior problems (Anderson and Marinier, 1997). The authors claim that a significant benefit may be obtained by feeding dogs according to their preferences, that is, giving them a choice in the foods they eat. By merely adjusting the diet to reflect the dog's preferences (e.g., feeding fresh meat, well-cooked vegetables, and raw knuckle bones) and avoiding excessive exercise or excitement, they claim that behavioral complaints were drastically reduced in 98% of the 100 dogs observed in their study. Unfortunately, as a result of limited information concerning the procedures used to assess behavioral change and collect data, the absence of experimental controls, a lack of rigorous statistical analysis, and other experimental design problems, it is impossible to assess the value of these findings. For what it is worth, however, Beaver and colleagues (1992) found that most dogs prefer meat over vegetables, especially cooked fresh meat, which they prefer over raw meat. When given a choice, their top choices were fried liver with onions (see the following note) and baked chicken, followed by cooked beef and fish. Aged meats (cooked and raw) were significantly less attractive than fresh cooked meats. The least attractive food items were fruits. (*Note:* Onions are toxic to dogs and can cause hemolytic anemia, a blood disease in which red blood cells are damaged and destroyed. Dogs should not be fed onions.)

Dietary supplements that may have some merit for the management of SDS are milk products containing casein. Casein is found in milk powder and cottage cheese. The digestion of casein produces casomorphins, naturally occurring opioids that are absorbed into the bloodstream (Panksepp et al., 1985). Other exorphins (or exogenous opioids) are produced as the result of the duodenal digestion of cereal glutins (Ballarini, 1990). Since separation-distressed animals appear to be highly responsive to morphine, it would seem

sensible to investigate the effect of casomorphins and other exorphins on separation distress. Perhaps the habit of sending children off to school after a meal of cereal and milk is no accident, but an unwitting nutritional remedy for the reduction of childhood separation anxiety. The notion that casein from the mother's milk might mediate social attachment by way of an opioid mechanism offers some intriguing, but as yet untested, possibilities with regard to the influence of nutrition on attachment and separation-related behavior. Whatever the specifics, attachment and separation are orchestrated by an intricate web of psychological and physiological interactions involving complex neural systems regulating emotions associated with comfort and distress.

Finally, considering the significant role of 5-HT in the regulation of impulsive behavior, the modulation of fear and anxiety, and the neural management of stress, it would seem advisable to provide separation-reactive dogs with a diet that maximizes the utilization of nutritionally derived tryptophan (see *Diet and Serotonin Activity* in Volume 1, Chapter 3). Diets combining low-protein and high-carbohydrate content appear to increase the availability of peripheral tryptophan, the amino acid precursor of 5-HT. In addition, increased exercise may stimulate increased 5-HT production and help optimize tryptophan transport across the blood-brain barrier (Meeusen and De Meirleir, 1995)(see *Exercise and Diet* in Chapter 3). In addition to providing an acceptable outlet for agitated oral activity, chewing may evoke an insulin release enhancing tryptophan access to blood-brain barrier transport molecules (see *Nutrition and Aggression* in Volume 2, Chapter 6).

Early Stimulation, Separation Exposure, and Emotional Reactivity

The successful control and management of SDS depend first and foremost on accurate diagnosis and complementary behavior therapy (Marder, 1991). Although drugs may help in some cases, the long-term benefits of drug therapy depend on the implementation of behavioral techniques designed to help improve the quality of the human-dog relationship and to enhance the dog's ability to cope with separation. Medicating dogs exhibiting separation panic and anxiety problems on a long-term basis in the absence of behavior therapy and training is a highly questionable practice and should be avoided.

As the result of prenatal and postnatal stress, social or environmental deprivation, disorderly or abusive social interaction, excessive restraint, traumatic loss of trust, or a failure to form a trust-based bond, dogs may be predisposed to show reactive rather than adaptive coping styles in response to stressful circumstances. Dogs that have lost their ability to form reliable control expectancies may fixate on reactive adjustments, that is, develop behavior problems in association with a persistent condition of behavioral stress and tension stemming from an inability to experience relief or obtain reward. From the cynopraxic perspective, the working assumption in such cases is fivefold:

1. The dog has become incompetent as the result of a failure to establish an adaptive behavioral framework of prediction-control expectancies with which to obtain its basic needs for comfort, safety, and reward.
2. The dog needs a highly predictable and controllable base of interaction with a friendly human leader to attain the behavior- and mood-modifying benefits of reward produced by positive prediction error and adaptive modal activity.
3. Effective prediction and control lead to competence, confidence, and the counterconditioning benefits of relaxation inherent to an adaptive coping style.
4. By means of affectionate and fair exchanges involving petting, food, and play performed in the context of cooperative and mutually rewarding interaction, a potent normalizing effect is produced.
5. The outcome of such interaction is a friendly and stable bond and an enhanced life experience for both the owner and the dog.

Behavioral distress is expressed in the form of anxiety and frustration, whereas tensions take

the form of increased irritability, intolerance, and emotional reactivity. Anxiety and frustration are closely associated with the development and expression of dysfunctional prediction-control expectancies. Anxiety is a state in which a dog is unsure of its ability to predict a pending event, whereas frustration is the result of a failure to control the event once it occurs. Together, anxiety and frustration form a problematic axis of failure with respect to the attainment of emotional relief and reward. Competency is restored through attention and basic training, integrated compliance training, posture-facilitated relaxation (PFR) training, and other reward-based techniques and procedures, providing the dog with the means to learn and to expect relief and reward by behaving in accord with predictive signals. Training and behavior-modification strategies emphasizing intrusive and aversive loss of control in such cases may only worsen the dog's chances of recovery.

The precise causal mechanisms underlying SDS are not known, but many likely etiological factors and coactive influences have been identified (see *Separation Distress and Coactive Influences* in Volume 1, Chapter 4). Although the formation of excessive attachment and dependency appears to play contributory roles, many dogs are exposed to such influences without becoming overly reactive when left alone. Dogs unaccustomed to being left alone may not have acquired the emotional coping skills needed to accommodate the stress produced by abrupt separation. Dogs exhibiting unstable-introverted temperaments (melancholic) may be more prone to develop separation-related problems associated with anxiety (despair), whereas dogs exhibiting unstable-extraverted temperaments may tend to develop separation-related problems associated with frustration (protest). Whether SDS is associated with symptoms of anxiety or frustration, the panic emotional command system appears to mediate the expression of separation distress (Panksepp, 1998).

Numerous theories have been postulated to help explain developmental disturbances resulting in excessive distress or panic at separation (see *Attachment and Separation* in Volume 1, Chapter 4). A convincing account remains to be fleshed out, but genetics (see Lakatos et al., 2000; and Hofer et al., 2001), early stimulation, and traumatic experiences with separation probably all play a significant role in the etiology of SDS. Neonatal traumatic handling and excessive environmental stress resulting from excessive temperature changes, nutritional deprivation, physical trauma, maternal neglect or isolation, inadequate housing, or abuse may exert a lasting adverse effect on neurobiological substrates mediating stress and stress-related coping behaviors. An absence or an excess of postnatal stress may produce long-term adverse effects on a dog's health, emotional reactivity, and its ability to cope with stressful situations, that is, situations requiring adaptive adjustments.

Prenatal Stimulation

Prenatal stress appears to affect adversely a progeny's ability to cope with environmental and psychological stress. Thompson (1957) found that exposing gestating female rats to intense fear-eliciting stimulation resulted in unstable and emotionally overreactive offspring. Human infants of depressed mothers exhibit a variety of endocrine and behavioral changes associated with increased sympathetic arousal (e.g., high cortisol and NE levels coupled with low DA and 5-HT levels). Such babies appear to exhibit depressive tendencies, including decreased orienting responsiveness, flat affect, reduced activity levels, and increased irritability. Providing the rat mother with stimulation appears to produce a beneficial effect in her offspring. Adler and Conklin (1963) found that exposing gestating rat mothers to repeated daily handling helped to reduce emotional reactivity in their offspring as adults. Prenatal stress, in the form of unpredictable noise and light stimulation occurring three times weekly, during the gestation period increases basal levels of corticosterone as well as sensitizes the sympathetic-adrenomedullary (SAM) system to stress, as evidenced by increased secretion of NE and epinephrine in response to foot shock (Weinstock et al., 1998). Animals exposed to excessive prenatal stress exhibit attentional deficits, increased anxiety, and disturbed social behavior. Prenatal stress dysregulates the HPA system. In response to aversive stimulation,

prenatally stressed animals exhibit a prolonged elevation of peripheral glucocorticoid levels, together with decreased negative-feedback inhibition of CRF release by the hypothalamus. In addition, animals stressed during gestation show higher levels of CRF in the amygdala, have fewer glucocorticoid receptor sites in the hippocampus, produce fewer opioid peptides, and exhibit decreased GABA-benzodiazepine inhibitory activity (Weinstock, 1997). In combination, the effects of prenatal stress are pronounced and potentially very influential on the emotional and behavioral development of dogs. Gestating females should be shielded from excessively stressful conditions and receive regular play and other enrichment activities. Postparturient mothers showing signs of stress, anxiety, or depression may benefit from brief biweekly massage (Field et al., 1996a,b).

Postnatal Stimulation

Postnatal stimulation appears to exert pronounced effects on an animal's ability to cope with emotionally provocative situations and stress as an adult. Considerable research has demonstrated that postnatal handling of rats during the first 3 weeks of life permanently alters the way in which they cope with environmental and psychological stressors. Briefly handled rats show decreased levels of CRF, ACTH, and plasma corticosterone levels, appearing to significantly benefit from such exposure to stress. In addition, such animals show an improved ability to recover homeostatic balance (return to basal corticosterone levels) after the stressor is removed (Plotsky and Meaney, 1993). According to Denenberg (1964), an inverse relationship exists between the amount of stimulation that a neonate receives and its emotionality as an adult. High levels of neonatal stimulation are correlated with reduced adult emotionality, whereas low levels are correlated with increased adult emotionality (Figure 4.5). Dennenberg's curve holds true only with respect to stimulation occurring within an optimal range of exposure, with excessive amounts of early stress producing adverse effects on a dog's development. Puppies that receive inappropriate, insufficient, or excessive contact stimulation and separation exposure may be more prone to exhibit problematic emotionality at separation as adults. The aforementioned studies involving stressful maternal separation show that excessive neonatal exposure to stressful isolation results in lasting disturbances in CRF and HPA activity. Maternally stressed animals exhibit an increased sensitivity to stress and show heightened emotional reactivity and anxiety when exposed to aversive situations, effects also exhibited by animals shielded from environmental stress in infancy. The effects of maternal stress appear to be dose dependent, with little or no stimulation in infancy producing similar sorts of effects as seen in the case of animals exposed to excessive stress (Plotsky and Meaney, 1993). In addition to modulating stress and emotional reactivity beneficially, early handling may improve a dog's ability to cope with adversity and thereby enhance its trainability and problem-solving abilities (see *Early Development and Reflexive Behavior* in Volume 1, Chapter 2). Unfortunately, scant data is available to

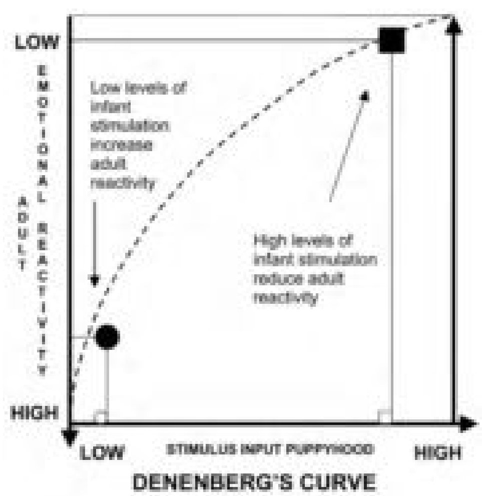


FIG. 4.5. Early infant stimulation exerts a pronounced effect on adult reactivity levels. Whereas moderate levels of tactile stimulation and environmental stress produce a beneficial effect on reactivity levels, too little or too much stimulation may produce adverse effects by increasing adult emotional reactivity levels (choleric type) or decreasing adult emotional reactivity (melancholic type), respectively. Adapted from Denenberg (1964).

confirm the benefits of early handling in dogs, but extensive research with rodents and anecdotal reports of benefits in working dogs (e.g., the Biosensor Research Team) suggest that handling may be a valuable husbandry tool in the case of military working dogs (Fox, 1978).

Handling and Gentling

Various handling procedures have been suggested for maximizing the benefits of early stimulation. The techniques vary but typically involve repeated brief periods of maternal separation from birth to 3 to 5 weeks of age, although postnatal week 1 may be the optimal period for handling effects to occur (Fox, 1971). The necessary amount of handling stress probably varies significantly from breed to breed and individual to individual, depending on genetic predisposition to stress. In addition to maternal separation, thermal stress (placing a puppy on a cold surface) and vestibular stimulation (produced by rocking a puppy side to side on a tilting board) for 1-minute periods each have been suggested by Fox (1978). Fox also recommends that thermal stress and vestibular stimulation be followed by an equal time devoted to gentle stroking. The Monks of New Skete (1991) place individual neonates into cardboard boxes and leave them there for 3 minutes, followed by a period of gentle stroking before the puppy is returned to its mother and littermates.

Perhaps, simply picking a puppy up daily and weighing it on a cold wobbly scale may provide sufficient biological stress to integrate a balanced flight-fight system. Further, given the potential long-term risks associated with maternal separation distress, perhaps adversely sensitizing stress-mediating circuits and inadvertently increasing the puppy's risk of showing stress-related problems in adulthood, the possible health and behavioral benefits of exposing puppies to such stress may not outweigh the potential harm. Consequently, without additional and unambiguous evidence concerning the benefits of such treatment for puppies, exposing neonates to maternal separation and isolation distress might best be avoided until appropriate studies are performed to show, first of all, that isolation distress is beneficial, and then to precisely define the dosage needed, that is, how much isolation exposure is beneficial and at what point does it become harmful. Puppies without a mother should receive intensive neurological stimulation produced by evoking the full range of neonatal and transitional reflexes described by Fox (1965) (see Figure 2.4 in Volume 1).

Gentling refers to procedures in which a puppy is stroked while being held in various nonthreatening positions. In addition, the handler may gently blow breath around the puppy's head and face. Field and colleagues (1996b) have found that massaging infants delivered to depressed mothers exerts significant benefits on attention, emotionality, and sociability test scores. Such infants are often born with stress-related changes, including increased cortisol and catecholamine levels, both of which are significantly reduced by two 15-minute periods of massage per week. The puppy can also be exposed to brief periods of massage while restrained in various positions (stand, sit, down, and lateral roll). Brief restraint represents a mild source of stress, and massage may help a puppy learn to modulate and refine its response to it. Gentling is believed to enhance bonding and taming. Among rats, postweaning gentling has been shown to exert significant benefits, including enhanced learning and retention, increased exploratory behavior, improved competitive success (social dominance), and improved stress response (Morton, 1968). Gentling may be particularly beneficial in the case of puppies exhibiting signs of excessive fear or contact aversion.

Exposure to maternal separation distress, cold, and distressful noxious manipulations appears to integrate a potent flight-fight stress system via AVP and CRF. In contrast, the repeated nonnoxious evocation of oxytocin release appears to integrate an antistress response (see *Oxytocin-opioidergic Hypothesis* in Chapter 6), producing numerous short-term and long-term physiological benefits conducive to calming and growth (Uvnäs-Moberg, 1997a)—high priorities of early puppyhood. Rhythmic stroking, warmth, and vibratory stimuli have been shown to produce a highly beneficial release of oxytocin

(Uvnäs-Moberg, 1998). The postnatal release of oxytocin produced by repetitive massage-like stroking (strokes lasting 1.5 seconds) has been shown to have long-term beneficial effects on blood pressure and irritability thresholds (Lund et al., 2002), appearing to counter the adverse effects of prenatal stress in rats (Holst et al., 2002). Such stimulation has also been shown to exert an anti-anxiety effect (Windle et al., 1997), and repeated exposures to oxytocin-releasing stimulations help to restrain HPA-system activity (Peterrson et al., 1999). These findings strongly support the hypothesis that supplemental rhythmic massage and tactile stimulation may be of significant benefit for promoting an adaptive response to stress.

Exposure to Separation

Distress vocalization in response to separation from mother and littermates rapidly increases after 21 days and peaks at 31 days (Gurski et al., 1979). Elliot and Scott (1961) found that repeated early exposure to separation distress progressively enhanced the puppy's ability to cope with isolation in a strange place (see *Social Attachment and Separation* in Volume 2, Chapter 2). Puppies exposed to weekly 10-minute periods of separation beginning at week 3 and continuing through week 12 exhibited the least amount of distress when tested at week 12 in comparison to puppies first exposed to separation at weeks 6, 9, and 12. Twelve-week-old puppies that had not been previously exposed to separation were found to be highly reactive to isolation, showing a steady increase in separation distress over the 10-minute test period. Puppies previously exposed to separation appeared to have learned how to cope more effectively with it, exhibiting much less distress. Although puppies can habituate to isolation as the result of repeated exposure to uneventful separations, this capacity appears to develop slowly and may not be functional until a puppy is 7 or 8 weeks of age (Hetts, 1989). Interestingly, in contrast to Elliot and Scott's findings, Hetts found that 12-week-old puppies, despite a previous lack of exposure to separation, showed a distinctive pattern of inhibition involving a decrease in distress vocalization and activity when isolated for the first time at week 12. Further, when tested at week 16, these puppies not previously exposed to isolation from weeks 4 to 12 produced significantly fewer distress vocalizations than did puppies repeatedly exposed to isolation consisting of 10 minutes/day for 6 days a week over that same period. These findings obviously conflict with those of Elliot and Scott, suggesting the need for additional research to resolve the question concerning the optimal procedure for exposing puppies to separation.

Hetts' findings seem to suggest that separation distress is relatively immune to habituation effects from week 4 to week 8, which is interesting with respect to onset of weaning. The finding that naive 12-week-old puppies showed less distress vocalization and activity during the first 30 minutes of testing at week 12 than did puppies previously exposed to isolation is consistent with an emergent inhibitory fear response associated with a strange place. Under natural conditions, distress vocalizations might attract danger, making its inhibition an appropriate response given the circumstances and the puppy's age. For example, if feral, a 12-week-old puppy might be left alone for long periods at a relatively unfamiliar rendezvous site without the mother's protection, requiring that it remain quiet and inconspicuous until her return. A genetically programmed timetable for a reduction in distress vocalization at around week 12 would make evolutionary sense. The lack of a comparable or better reduction in distress vocalization in the group of puppies repeatedly exposed to isolation might be attributable to an habituation effect reducing the puppy's fear of the isolation situation, thereby causing it to feel more relaxed to express its discontent. However, these puppies did show a significant reduction in distress vocalization as the result of habituation from week 8 to week 12, whereas a third group of puppies, isolated for 1 hour/week over the 8-week period, did not show evidence of a reduction in distress vocalization and showed no difference with respect to activity level in comparison to the frequently and repeatedly exposed group. This finding seems to indicate that while 1 hour of exposure was sufficient to habituate fear toward the isolation situation,

it was not sufficient to habituate separation distress.

Finally, Hetts' results suggest that a puppy's ability to cope with separation distress may significantly improve as it matures, a finding that lends some credence to Slabbert and Rasa's suggestion that adoption delayed until week 12 is less stressful and yields health benefits (Slabbert and Rasa, 1993) (see *Adoption and Stress*). Perhaps, in the case of households in which a puppy will be exposed to a great deal of daily separation and isolation, delaying adoption to week 12 might be preferable to adoption during week 7, but only if the preadoption situation provides the puppy with adequate socialization and training in preparation for its future home life (e.g., house training).

Punishment and Separation

Increased attachment and inordinate separation distress may paradoxically result from excessive disciplinary interaction. Fisher (1955) found that puppies that were exposed to a combination of social indulgence and punishment exhibited the most pronounced dependency and proximity-seeking behavior (see *Separation Distress and Coactive Influences* in Volume 2, Chapter 4). A pattern of excessively punitive and indulgent interaction occurring early in the socialization process may predispose a dog to show social conflict and reactive behavior in adulthood. Such interaction may sensitize pathways associated with threat-avoidance behavior and produce a conflict-laden attachment with the owner. During punitive interaction, the owner, otherwise a source of comfort and safety, temporarily becomes a serious threat from which the puppy seeks protection, often by soliciting it from the owner in the form of fearful submission displays—a social conflict dynamic that may be permanently codified into a problematic stress-antistress mosaic of neuropeptide activity (see *Developmental Adversity and Adjustment*). Later, under the influence of social transactions involving emotional exchanges or loss at separation, these stress-antistress factors may express themselves in adult coping responses that may include persistently intrusive and excitable behaviors, on the one hand, and intensely emotional, provocative, and reactive behaviors, on the other. Excessively indulgent and punitive interaction contributes to the intensification of a problematic and conflicted attachment process. Scott (1992) points out the potency of both attractive and aversive interaction to facilitate attachment by way of a general hypothesis:

> The occurrence of any strong emotion, whether pleasant or noxious, will speed up and intensify the process of attachment. (84)

Overattachment involving excessive indulgence and punitive interaction may result in a developmental fixation and a regressive dependency and intolerance for separation from the owner, or foster an adversarial and conflict-prone relationship, perhaps setting into motion social dynamics conducive to adult aggression problems, or both. Alternating between intense emotional stimulation of hedonically opposite and incompatible valences, especially when delivered indulgently and noncontingently (e.g., belated punishment) is highly destructive and without justification. Ultimately, the degree of harm resulting from such treatment depends on hereditary factors and subsequent behavioral support. Dogs genetically expressing low fear or anger thresholds may be particularly vulnerable to the lasting effects resulting from mistreatment.

Attachment and Separation Problems: Puppies

Adoption and Stress

Sudden changes in routine (e.g., amount of attention, exercise, or restriction) that a dog is accustomed to receive may produce significant biological stress, perhaps inducing emotional and behavioral disturbances in predisposed dogs. For example, moving a dog, accustomed to sleeping in a crate in the kitchen, to a bedroom may result in intense restlessness and inability to calm down. Some dogs pace, pant, and drool, appearing highly distressed by the change. Although puppies appear to be much more resilient and adaptable than adult dogs to change, it is reasonable to assume that separation-related distress

associated with adoption may produce lasting adverse effects if not properly managed. The timing of adoption and placement of puppies may also have a strong effect on development, health, and behavior. Slabbert and Rasa (1993) found that German shepherd puppies removed from their mothers at week 6 thrived poorly and showed a significantly greater risk for disease and mortality than did puppies naturally weaned by their mother between weeks 7 and 8. They also exhibited significant behavioral deficits: "Puppies weaned before 7 weeks of age are noisy and nervous. These seem to become fixed characteristics of the dog for life" (5).

Puppies allowed to stay with their mothers through week 12 were healthier, gained more weight, and appeared better adapted. However, the significance of early adoption on the incidence of SDS has been questioned. For example, Flannigan and Dodman (2001) were unable to detect a correlation between early adoption (earlier than 7 weeks of age) and an increased risk of developing separation-related problems in comparison to other behavior problems. The authors do, however, leave open the possibility that puppies adopted at an early age may be generally more susceptible to behavior problems. Deferring adoption until week 12 conflicts with standard practice, and any potential benefit of delayed adoption would depend on the quality of socialization, habituation, and training taking place during those critical weeks while a puppy remains under the breeder's control. Ideally, a dog destined to become a family companion should be placed at around week 7, based on a number of compelling scientific considerations, practical management issues (e.g., house training), and social bonding benefits (see *Secondary Socialization (6 to 12 Weeks)* in Volume 1, Chapter 2). As previously discussed (see *Exposure to Separation*), an exception to the week 7 rule of thumb rule might involve puppies destined to households in which they will be exposed to lengthy daily separations and isolation.

From a familiar environment and social setting, a newly adopted puppy is thrust into quite a different situation of unfamiliar sights, sounds, smells, and social demands. In addition to environmental strangeness, this new situation is probably governed by rules and expectations that sharply conflict with previous learning and social experiences. Some dogs may never fully overcome this momentous loss of filial kinship and sense of security. In combination, the abrupt loss of affiliative bonds and loss of place attachments may create a highly stressful state of disorientation and confusion, perhaps verging on helplessness when coupled with adverse rearing practices (see *Adverse Rearing Practices That May Predispose Dogs to Develop Separation-related Problems* in Volume 2, Chapter 4). Helplessness and excessive dependency are natural behavioral corollaries of excessive confinement and punishment during puppyhood.

Although many factors play a role in the development of separation-related anxiety and panic in adult dogs, the manner in which this original separation trauma is managed probably plays some role in predisposing vulnerable puppies to develop the adult disorder or helping to prevent it. Obviously, there is a natural tendency for puppies to rely on previously acquired behavior patterns in an effort to cope with the demands of family life. Some of these behaviors are conducive to a harmonious transition, while others may set the groundwork for significant interactive conflict and potential problems. Despite the potential pitfalls and difficulties, it is truly remarkable how well most puppies navigate the transition into family life, underscoring the average puppy's high degree of behavioral and emotional flexibility. Clearly, the young dog is very adaptable and, when problems do occur, more often than not they are the result of improper training or mismanagement. With these considerations in mind, it makes sense to provide newly adopted puppies with careful transitional handling and training in an effort to reduce the amount of stress associated with adoption. The first step in making a successful transition is to recognize that the puppy is probably experiencing significant stress and disorientation, despite outward signs that may seem to indicate otherwise. The energetic and rough efforts of children to play with a new puppy are probably not beneficial. What the puppy needs during the transitional period is gentle handling, nourish-

ment, and quiet surroundings, especially for the first few days.

Coping with Stress at Separation

A significant source of emotional distress for puppies is associated with the strain and upset elicited by separation and confinement (Borchelt, 1989). The average puppy has not had very much prior experience with being left alone and may not cope well with even brief periods of separation. For many puppies, learning to cope with loneliness and isolation without excessive worry and distress is a hard lesson for them to master, and their success will depend on the patient guidance and support of understanding owners. Initially, the puppy should be allowed to sleep in the bedroom, and only gradually moved to another part of house—if such an *unnatural* arrangement is necessary. If available from the breeder, a familiar soft toy or towel possessing the odor of the mother may help to pacify the puppy at bedtime and when left alone during the daytime. One possible method for breeders to explore is to associate the mother with a distinctive dilute odor throughout the nursing period. The odor can then be bottled and given to the owner to spray on bedding and so forth, perhaps providing some relief to the puppy at times when it needs to be left alone. Alternatively, the breeder may wipe the mother from head to toe with a damp cloth and rinse it in a quart of spring water. Wiping the area of the intermammary line may be particularly useful, since it is reportedly associated with the production of appeasing pheromones in lactating dogs (see *Dog-appeasing Pheromone*). The water can be stored in a spray bottle (refrigerated) and applied to bedding and locations where the puppy is confined.

Confinement

Confinement is useful for facilitating early house-training efforts, to prevent household damage, and for the sake of the puppy's safety in the owner's absence. This will require that the puppy be introduced to some amount of crate confinement. It is important that the puppy form a positive place attachment with the crate. The crate should be equipped with soft toys (stuffed animals and knotted towels) and blanketing—all of which may help to pacify and relax the puppy. In addition, some puppies may benefit from a mirror securely attached to the outside of the crate or nearby wall. Although most puppies can be trained to accept crate confinement without too much trouble, some may rebel despite the most patient and systematic efforts to desensitize them. Such persistent and demanding puppies may find crate confinement highly frustrating and vigorously protest against it. It is important to exercise careful judgment here and not mistake frustrative protests against confinement as separation-related panic. Vocalizations associated with separation-related panic are not under the same degree of voluntary control as vocalizations exhibited by difficult and frustrated puppies. In such cases, exposure to crate confinement might be carried out via a folding pen that is gradually made smaller, while the crate is made attractive and comfortable.

Many crate-training problems can be avoided by slowly introducing such confinement through gradual steps (see *Crate Training* in Chapter 2). Finally, regardless of the reasons for confining a puppy, it should be done in a part of the house that is familiar to the puppy (e.g., the kitchen or bedroom). The highly questionable practice of isolating the puppy or family dog in the basement or garage during daily absences is associated with an increased risk of heightened separation distress and panic.

All normal puppies are stressed by separation and may vent their displeasure through intense vocalizations aimed at getting the owner's attention or engage in other activities (e.g., chewing baby gates) aimed at securing contact. Allowing a puppy to persist in such stressful isolation behavior may inadvertently potentiate separation-distress reactions. On the other hand, routinely responding to such protests with affectionate reassurance or by releasing the puppy from confinement may only serve to reinforce such unwanted behavior. Diverting the puppy with a treat or sound (e.g., a squeak) and requiring that it remain quiet for some brief period before releasing it is probably better than just rescuing it at such

times. Although the puppy's sensitivity to isolation usually decreases as it matures, it is still important that the puppy learn how to cope with such situations without experiencing excessive distress. This is usually accomplished through graduated exposure and desensitization. Training a puppy to accept isolation is accomplished by scheduling opportunities for social contact, exercise, and play in exchange for short periods of confinement and separation—a process that is carried out concurrently with early crate training. Separation training instructs the puppy to anticipate regular attention and contact based on contingent waiting and quiet behavior. Although intensive affection, stroking, massage, and feeding by hand may help to counter the stress associated with adoption, social contact should gradually approximate the amounts of attention and contact that will likely be provided to the dog as an adult.

Graduated Departures

Graduated exposure to brief and nonthreatening separation experiences may help to immunize a puppy against the stressful effects of more lengthy separation (Voith, 1980; Marks, 1987). Training a puppy to accept limited exposure to separation can be accomplished by gradually exposing it to increasing periods of crate or pen confinement. The crate or pen should be placed in a room where the puppy is left when the owner is away from home. Once the puppy can tolerate being left alone in the room, the next step is for the owner to begin leaving the house for varying lengths of time, thereby gradually increasing the puppy's tolerance for owner departures and absences. The goal of such training is to help the puppy to anticipate the owner's return optimistically while systematically reducing its aversion to being left alone. These safe and relaxed planned departure activities help the puppy to learn that separation is temporary and that the owner's eventual return is certain. Gradually, the puppy develops more positive expectations about separation events, learning to tolerate departures and to wait patiently for the eventual return of the absent owner.

From the very beginning, safety stimuli or bridges should be paired with every safe departure experience. Safety stimuli can be easily established by associating short, nonanxious departures with an auditory, visual, or olfactory stimulus (e.g., a scent associated with the mother or used during massage). Safety stimuli appear to give the puppy some sense of security when it must be left alone, perhaps by forecasting the owner's eventual return or by evoking conditioned associations of comfort and safety. The goal is to establish a positive association between safe separation experiences and ambient contextual stimuli. Also, just before leaving, the puppy is given a highly prized chew item made available primarily at such times (e.g., a hollow rubber toy slathered with peanut butter). With the puppy distracted by the toy, the owner turns on a radio or television and light and exists the room. After a brief separation, the owner returns, turns off the radio or television and light, goes to the puppy, and retrieves the chew toy. At the conclusion of a safe departure, the puppy is given a brief period of tug or fetch play, especially if signs of building stress are evident.

The aforementioned pattern of departure and return is repeated again and again, increasing and randomly varying the duration of departures. Care should be taken not to proceed too quickly, and closely observe the puppy for any signs of distress. If the puppy becomes distressed, the handler should return to a previously successful step and try again. In the case of highly sensitive and reactive puppies, the process of introducing safe and relaxed departures might begin by merely scooting back a foot or 2 before returning to the puppy to reward it. Standing up and walking 2 or 3 steps back and waiting for a 5 or 10 seconds before returning might be the next step, followed by a variety of similarly gradual departure steps organized to prevent the puppy from becoming distressed. Sometimes training the puppy to sit-wait and down-wait while in the crate can be useful in the context of planned departure training, gradually training the puppy to wait for longer durations, at greater distances, and involving progressively more difficult departure exposures (e.g., going around a corner, into another room, and finally outdoors). Varying the duration of separation by inter-

spersing short and long durations randomly is useful [e.g., 30 seconds, 15 seconds, 10 seconds, 1 minute, 20 seconds, 5 seconds, 45 seconds, 1 minute 30 seconds: variable duration (VD), 35 seconds]. The first 20 minutes of separation for a puppy are the most sensitive, with proper confinement training and desensitization focusing on the first 10 to 30 seconds providing a stable foundation and anchor for subsequent counterconditioning efforts. It is not necessary, therefore, to spend long hours desensitizing a puppy to separation, but to concentrate on the first minute or 2, gradually building up to 20 to 40 minutes. As the puppy progresses, add more varied and realistic departure experiences to the program, including picking up keys, slipping on shoes, putting on an overcoat, picking up a briefcase, and so forth (see *Graduated Departures and Separation Distress*).

Planned Separations

In addition to brief, graduated exposure to separation, other benefits may be obtained by exposing a puppy to more protracted periods of safe separation. Poulton and colleagues (2001) have reported that late-adolescent separation anxiety in children is negatively correlated with the number of overnight hospital stays away from home in early childhood, with more overnight stays away from home being associated with a reduced risk of separation anxiety. Also, as one might expect, the longitudinal study found that children exposed to planned hospital stays experienced fewer symptoms of separation anxiety in late adolescence than did counterparts exposed to unplanned hospitalization. The use of dog day care and overnight stays away from home in a safe and supportive environment may provide additional inoculation against adult SDS. Such recommendations should be seriously considered in the case of puppies showing evidence of excessive distress when left alone.

In the case of puppies that need to be left confined to a crate (e.g., needing such confinement for house-training purposes), with a high probability that heightened distress will occur while the owner is absent, a second crate might be used transitionally to avoid associating stressful arousal with the safe crate (Voith, 2002). In preparation for such departures, the puppy should be given a high-value chew item and put in the crate for at least 5 minutes before leaving. A fragrance such as lavender or chamomile might be sprayed initially and then diffused by means of a diffuser and aquarium pump (see *Taction and Olfactory Conditioning*). Although the author has not yet evaluated the usefulness of dog-appeasing pheromone, it is reportedly helpful in the management of distress at separation in puppies and dogs (see *Dog-appeasing Pheromone*).

During stressful habituation exposures to separation, the owner should avoid returning to the puppy while it is still aversively aroused. Instead, for example, upon returning from an errand, the owner should check first and make sure that the puppy is not vocalizing before entering the house. If the puppy is vocalizing and does not stop, the owner might call the home phone with a cell phone, perhaps momentarily distracting the puppy, whereupon the owner should enter the house and initiate a brief period of attention training (i.e., orienting response to a squeak followed by a click and treat), feeding the puppy through the crate door, but refraining from immediately letting the puppy out. As the puppy shows signs of calming, it is released and tossed a ball or engaged in sit and sit-stay training with a brief attending response, whereafter it is transitioned to the scented safe crate or confinement area. The foregoing method helps to control aversive arousal, enhances attention and impulse control during greetings, and associates opponent relief and relaxation produced by the owner's return with the safe crate and the olfactory safety signal (OSS). Habitually using the cell phone to call home prior to entering the house can establish a potent conditioned safety signal by association with the owner's homecoming. Alternatively, a remote doorbell and the sound of the garage door opening can be used to serve a similar purpose. The sound of the garage opening, the doorbell, and the phone are naturally conditioned in association with increased social activity and transition and can be used in a variety of creative ways as

diversionary stimuli to manage puppy and dog behavior.

Miscellaneous Recommendations

Taking measures to reduce or prevent separation distress is an important aspect of puppy rearing. In addition to the aforementioned recommendations, the following list of suggestions should be considered:

- Avoid excessively emotional interaction that might lead a puppy to become overly attached and dependent. Although a young puppy needs a great deal of attention and affection, the character of this attention need not be indulgent. Constructive interaction involving various training activities, walks, and instructive play is much better than just providing gratuitous affection and unearned treats.
- When leaving a puppy alone for extended periods, the puppy should be confined to well-socialized part of the house (e.g., the kitchen). Ideally, the puppy should be restrained in an exercise pen equipped with an open crate made comfortable with bedding. The floor of the penned area should be covered with several layers of newspapers for the inevitable accidents. *Do not restrict water.* Make an audio tape of the puppy's reaction to separation, thereby providing some baseline information about the puppy's response to it and improvement (or not) over time.
- Avoid overemotional departures and homecomings. Approximately 5 to 10 minutes before leaving the puppy, it should be placed in the pen and given a highly desirable chew item that is not provided at other times. Giving the puppy periodic treats during this time can help calm it. Puppies appear to benefit from the presence of a towel richly scented with the owner's body odor. Also, it may be useful to direct the puppy's attention to the towel as an object of play and contact when the owner returns home. Puppies prone to become overly aroused should receive 1 to 3 minutes of massage just before being confined and then again after homecomings.
- Avoid punishing a puppy for destructive behavior or elimination occurring during absences. Such punishment will not impact beneficially on the misbehavior and may make the situation worse. In general, aversive training methods should be minimized or avoided (if possible) during the transitional period immediately following adoption.

As a puppy develops, it will naturally become more confident and independent, with the puppy appearing to develop improved abilities to cope with safe separation exposure between weeks 8 and 12 (Hetts, 1989). With maturation, separation reactions usually decrease in intensity, unless—because of excessive frustration, inappropriate punishment, or inadvertent reinforcement—the puppy learns to persist in such undesirable behavior. With maturation, reactive separation behavior usually moderates as a secure and balanced social relationship is established between the owner and the dog. However, as the result of adverse interaction (e.g., social frustration, inappropriate punishment, or inadvertent reinforcement), the dog may form a problematic attachment and express persistent separation-related distress when left alone. The social competence provided by structured integrated compliance training, in combination with habituation and graduated exposure to separation events with counterconditioning, appears to exert an ameliorative and preventive effect on separation distress. However, extensive early socialization and training efforts away from the home may not be beneficial. According to Bradshaw and colleagues (2002), extensive exposure to varied social contacts at approximately month 3, involving persons not belonging to the family, strangers, or children, may predispose puppies to exhibit problematic separation-related behavior between months 6 and 9. Conversely, extensive social exposure between months 6 and 9 appears to exert a protective influence by reducing the risk of subsequent separation-related behavior. These findings suggest the possibility that socialization with varied people and situations away from the home in early puppyhood (e.g., puppy socialization classes) may not be beneficial with respect to separation-related adjust-

ments, whereas added separation-related benefits may be obtained as the result of attending group training classes and providing diversified socialization experiences after month 5 or 6.

McBride and colleagues (1995) have reported that dogs (N = 44) rehomed from an animal shelter between 6 and 12 months may be at greater risk of developing separation-related behavior problems than dogs adopted in other age groups. Perhaps, during this important developmental transition between puppyhood and adulthood, there exists a period of increased vulnerability to the emotional effects of attachment and separation. However, another possible association may exist that should receive additional research. This time frame is commonly associated with neutering, a procedure that has been implicated as a potential risk factor in the development of separation problems. Flannigan and Dodman (2001) have found that sexually intact dogs were three times less likely to exhibit separation problems than neutered counterparts (male and female). With respect to the influence of sheltering on the incidence of separation-related problems, in addition to the traumatic loss of attachment objects suffered by the relinquished dog, the sheltered dog may subsequently form strong place and social attachments with the shelter environment and workers. In addition, the daily stimulation of cleanup, feeding, and other care activities, the presence of other dogs, periodic visits, and exercise opportunities may significantly contrast with the humdrum loneliness of the adoptive home environment. Sheltered dogs appear to form rapid attachments, requiring as few as three meetings with a stranger consisting of 10 minutes each to show a significant increase in attachment behavior (Gácsi et al., 2001). A shelter dog may be sensitized in various ways to attachment processes that predispose it to become emotionally vulnerable when left alone.

PART 2: SEPARATION DISTRESS AND PANIC: TREATMENT PROCEDURES AND PROTOCOLS

Attachment and Separation Problems: Adult Dogs

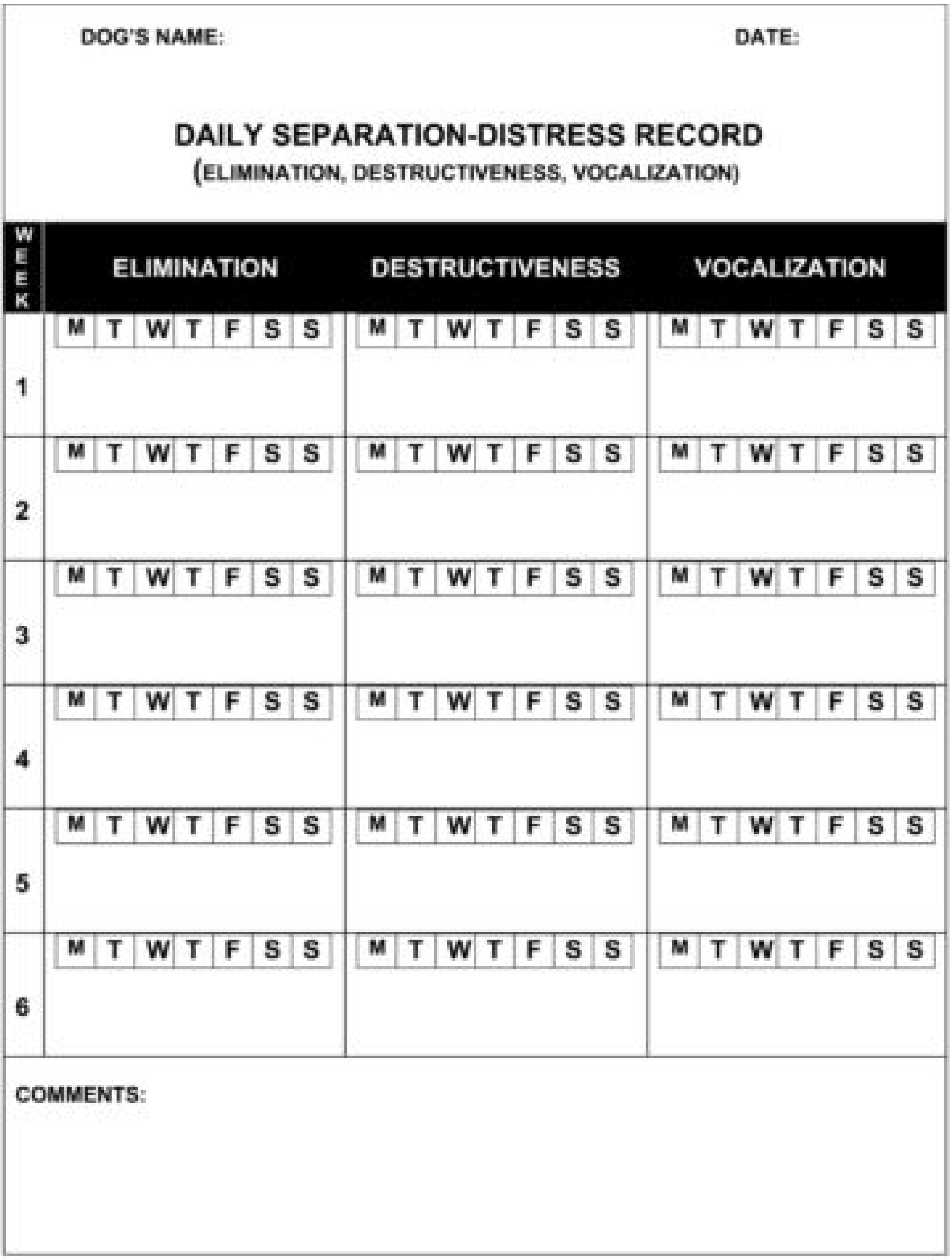
Most dogs appear to accept daily exposure to long periods of separation without showing excessive distress. Separation-reactive dogs, however, exhibit a distinct and persistent pattern of generalized arousal, protest, or excessive worry when left alone. SDS is identified by a cluster of diagnostic signs and symptoms involving a variety of biobehavioral modalities, including appetitive, oral, vocal, motor, eliminative, and physiological changes (Table 4.1).

Diagnostic Signs of Separation Distress

Few dogs exhibit all of the aforementioned signs listed, but many show more than one sign, and it is not uncommon for separation-distressed dogs to exhibit several of the behavioral signs of distress whenever they are left alone. Owners should be encouraged to maintain a behavioral journal, including a record of separation-related behavior in order to produce an objective assessment of the benefits of training and behavior therapy (Figure 4.6).

Table. 4.1. Diagnostic signs of separation-distress syndrome (SDS)

Excessive attachment (clinging behavior)
Predeparture restlessness
Separation-distress vocalization (e.g., barking and howling)
Destructive behavior only when left alone
Self-injurious behavior
Urination and defecation only when the owner leaves
Separation-related loss of appetite
Excessive greeting behavior



DOG'S NAME: DATE:

DAILY SEPARATION-DISTRESS RECORD
(ELIMINATION, DESTRUCTIVENESS, VOCALIZATION)

WEEK	ELIMINATION	DESTRUCTIVENESS	VOCALIZATION
1	M T W T F S S	M T W T F S S	M T W T F S S
2	M T W T F S S	M T W T F S S	M T W T F S S
3	M T W T F S S	M T W T F S S	M T W T F S S
4	M T W T F S S	M T W T F S S	M T W T F S S
5	M T W T F S S	M T W T F S S	M T W T F S S
6	M T W T F S S	M T W T F S S	M T W T F S S

COMMENTS:

FIG. 4.6. Daily separation-distress chart. The day of the week is checked and a brief note concerning the separation-related behavior is recorded (time of day, location, object, and duration, and so forth).

Appetitive Signs

Separation-distressed dogs are usually anorexic. Some will even ignore a fresh beef bone or other highly prized food items until the owner returns. Separation-induced anorexia can be very problematic when it involves dogs being boarded or hospitalized.

Oral Signs

Many separation-distressed dogs are destructive when they are left alone. Among 200 dogs presenting with separation-related problems at Tufts Animal Behavior Clinic, destructive behavior was the most common complaint, with 71.7% of the dogs showing some form of household destructiveness when left alone (Flannigan and Dodman, 2001). These findings roughly correspond to those reported by Voith and colleagues (1997), in which the most common complaint associated with separation anxiety was destructiveness, followed by excessive vocalization, elimination, aggression, and overactivity. McCrave (1991) has differentiated destructive behaviors occurring with separation distress from destructive behaviors associated with other common etiologies. She has noted that separation-related chewing is typically directed toward points of egress, whereas playful destructive behavior is directed toward items "that are fun to toss or shred" (252), e.g., pillows, furniture cushions, and paper. These latter items are frequently targets of separation-distressed dogs as well, requiring careful analysis of the context and the presence of other signs to determine whether the destructive appetite is due to separation or other causes (see *Assessing Separation-related Problems* in Volume 2, Chapter 4). Separation-reactive dogs often scratch doors and dig at carpets in front of doors. Miller (1966) aptly describes this behavior as *barrier frustration*: "Frustration creates tension and the dog releases this tension, causing a problem like chewing. The single greatest frustration and tension builder is found in barriers, usually the door" (104). In addition to points of egress, destructive chewing is directed toward a wide variety of socially significant objects. In some cases, the chew object chosen by the dog appears to provide a symbolic link with the absent owner. Besides clothing, shoes, books, the television remote, pillows, and the owner's bed, separation-reactive dogs may chew on woodwork, curtains, furniture—almost anything that it can sink its teeth into, except, ironically, the chew toys that have been left for such purposes. Such compulsive chewing activity appears to provide an outlet for anxious feelings. But because the dog often chooses personal belongings as objects to gnaw on, the owner is often convinced that the dog is misbehaving out of spitefulness (Lindell, 1997).

Vocal Signs

Another common complaint associated with SDS is separation-related barking. Although barking is not the most common complaint, it is extremely common among dogs becoming reactive at separation. Voith and colleagues (1997) reported that 90% of separation-anxious dogs (N = 36) barked when left alone, with 80% engaging in destructive behaviors and 55% exhibiting elimination problems. Owners of such dogs are often prompted to seek help as the result of a citation or a neighbor's complaint. Sustained barking and howling are vocalization variations that many separation-reactive dogs exhibit—some to an astonishing extent. It is amazing how long a dog can bark and howl without stopping. Many owners return home daily to find their dog soaked with slobber from hours of agitated barking and panting.

Motor Signs

Many dogs become overactive at separation, with nervous pacing and bursts of frantic motor and exploratory activity occurring periodically during the day.

Eliminative Signs

In cases where the dog exhibits normal eliminatory control while the owner is at home, but loses control only when he or she leaves the house or denies contact to the dog, separation distress should be considered as a putative causal factor underlying the problem. Flannigan and Dodman (2001) reported that 28.1% of dogs with separation anxiety

showed some form of inappropriate elimination when left alone.

Physiological Signs

Separation-distressed dogs may exhibit a variety of signs indicating pervasive autonomic arousal, including trembling, panting, increased heart rate and, less frequently, profuse salivation or diarrhea.

In addition to the identification of emotional and behavioral signs of separation distress, dogs with SDS should be screened for phobias, especially noise and storm phobias. Flannigan and Dodman (2001) found that nearly half of dogs with separation-related problems also exhibit evidence of noise phobia. In cases where SDS occurs comorbidly with a phobia, the successful resolution of the separation problem requires that both problems be addressed (see *Prognostic Considerations* in Chapter 3).

Preliminary Considerations

Owners of dogs with separation-related behavior problems must first be convinced that their dog's misbehavior is not motivated by spite or vindictiveness. This is not always easy for one reason or another. Some owners may simply not want to get bogged down with behavioral explanations that portend difficult and time-consuming training efforts; they may have little patience in reserve and want immediate results. Others simply cannot rise above a heartfelt conviction that their dog is punishing them. An astonishing number of dog owners adhere to the belief that dogs often misbehave to spite the owner. In a large study, New and colleagues (2000) found that 48.3% of persons relinquishing their dogs to shelters held that dogs will misbehave to spite their owners, with nearly an equal percentage of owners (44.3%) with a dog living in the household indicating a similar belief concerning the spiteful motivation of canine misbehavior. The implications of spite and vindictiveness are distracting and misleading, but many separation-reactive dogs do appear to be more angry than anxious, appearing to protest at being left alone. Protest is a common behavioral sign of canine separation distress, resulting in persistent vocalization, increased motor activity, and destructive behavior (see *Separation Distress and Coactive Influences: Frustration* in Volume 2, Chapter 4). This situation is compounded when strong external pressures are demanding that the owner achieve results quickly or face dire consequences. Dogs are rarely brought for treatment of separation distress without some pressing behavioral complaint, including neighbor complaints, threats of eviction, or costly citations. What many of these owners want is a ready and easy means to suppress their dog's misbehavior—not a psychological explanation for it. Other owners welcome a scientific understanding of their dog's separation problems and willingly face the prospects of a daunting training process as a challenge and responsibility.

Every situation is a bit different, and it is of immense importance that problems involving separation distress be approached with an appreciation for each case's unique characteristics. Failure to take such matters into consideration will invariably impact adversely on compliance and the overall effectiveness of training efforts. Behavioral counseling is a pragmatic process based on a fluid dialogue between the trainer and the owner, often requiring compromise on minor points in order to build overall support and enthusiasm for the program. An owner's cooperation and confidence is won through a process of gradual persuasion and logical demonstration—not polarizing confrontation and criticism. Pressure tactics—no matter how accurate and brilliant—serve little purpose but to cause the owner to feel resentment toward the trainer. An experienced trainer listens to the owner's needs and assiduously avoids judgmental polemics. The cynopraxic trainer is a mediator showing the owner how to improve the situation, while avoiding narrow and one-sided prescriptions that the owner cannot accept or will not carry out. Consequently, wherever possible, the training program must be modeled to conform to the owner's needs and expectations.

Very few owners are able to implement the current planned-departure protocol for the treatment of separation distress in its entirety or apply it with the sort of diligence that the

procedure requires to optimize success. The underlying premise of such training is based on systematic desensitization and graduated counterconditioning. The owner is instructed to leave the dog for progressively longer periods, starting with a few seconds and gradually building the dog's tolerance for longer and longer periods of separation. While undergoing separation desensitization, the owner is instructed never to leave the dog alone under circumstances that may evoke separation distress or panic. This most central requirement is often impossible for owners to comply with, since it may entail considerable expense (e.g., day care or pet sitting) or inconvenience. Occasionally, a neighbor or relative will volunteer to watch the separation-reactive dog while it is undergoing training, but this is usually the exceptional situation rather than the rule.

Effective behavior therapy requires a high degree of competence in the application of a highly technical and exacting methodology. Desensitization procedures, in particular, assume a psychological understanding that may be natural for an applied dog behaviorist, but are often arcane and difficult for a dog owner to master. Most owners presenting their dogs for behavior therapy do not possess the self-discipline or understanding to adhere methodically to a behavioral plan. Describing the most general aspects of the process is easy, but the actual mechanics involved require the development of special skills and knowledge that may not be realistically attained in short-term counseling. Surely, many of the required skills cannot be fully mastered after a single session of counseling, but that is precisely what is often expected of the client-owner by the busy dog behavior therapist. This shortcoming of "brief therapy" may represent a serious danger for the owners of aggressive dogs who are expected to perform advanced behavior-therapy procedures after a single session of counseling. This situation can be somewhat mollified by supplementing verbal instructions with relevant reading material. Many articles and pamphlets have been written on the subject in a language that is accessible to the average owner, but few provide the sort of detailed instruction that would help the owner to apply the procedures meaningfully and consistently. Despite these shortcomings, most owners still report good results from the portion of the behavior protocol that they are able to carry out; even a few simple tips over the phone appear to help a great deal in some cases.

In addition to recording a thorough behavioral history, assessing separation distress is assisted by making an audio tape recording of the dog's reaction to separation. Besides monitoring the dog's behavior during a specific time frame and getting a picture of the sorts of things the dog does during separation, such recordings provide a baseline from which to gauge training progress or lack thereof. Although not all separation-anxious dogs bark or howl, a great many do, but even those that do not will often exhibit other signs of agitation that can be picked up by an audio recorder. A motion-activated video recorder can also be extremely useful for assessing separation behavior and tracking a dog's progress (Figure 4.7). Also, the owner should be encouraged to keep a behavioral journal for recording daily training activities and noting the dog's response to behavior-therapy efforts, such as planned-departure training. Records of planned departures should include the date and time, the length of departure, and a brief description of the dog's behavior (Figure 4.8).

FIG. 4.7. Motion-activated remote video system. Inexpensive video devices are available to record a dog's separation activities throughout the day. A motion-sensitive infrared detector turns on a remote VCR and turns it off again after a short period. A similar device could be devised to activate an air-pump odor dispenser and feeder described in Chapter 3 (see *Systematic Desensitization*, Figure 3.5).

DOG'S NAME: DATE:

SESSION NO.:

PLANNED DEPARTURE CHART

TRIAL	LOCATION	DURATION	DOG'S RESPONSE	PROBLEMS
1				
2				
3				
4				
5				
6				
7				

COMMENTS:

FIG. 4.8. Planned departure chart.

Behavioral training for separation-reactive dogs involves a variant application of systematic desensitization and instrumental training (Hothersall and Tuber, 1979). Departures are planned and graduated in such a way that the dog progressively learns to anticipate the owner's eventual return without experiencing excessive worry or distress. In additon, more appropriate waiting behavior is systematically reinforced. The systematic desensitization portion of this plan may be superfluous, especially if it is determined that the dog's

separation problems are motivated by frustration and protest. If fear is determined to play a role, then it may be more profitable to identify the fear-eliciting stimulus and desensitize the dog to it first, rather than attempting to desensitize the dog to separation while it continues to remain fearful of the situation. As already noted, in practice systematic desensitization by way of graduated departures is nearly impossible for the average dog owner to carry out. Very few people have the luxury to take two or three weeks away from work to administer a dog's desensitization training. Nonetheless, meaningful progress can be made by performing graduated departures while at home with the dog, counterconditioning predeparture cues, focusing efforts on shaping more appropriate predeparture behavior, and employing various techniques to improve the quality of attachment and interaction between the owner and the dog.

Summary of Behavioral Procedures Used to Modify Separation Distress

Podberscek and colleagues (1999) found that behavior modification without medication was effective for controlling behavior problems associated with separation-related distress. The eclectic program that they recommend involves four phases of therapy (Table 4.2). King and colleagues (2000) have described a similar treatment program used in conjunction with clomipramine, which they divide into these areas of focus:

At-home interaction
- Dog is ignored during greetings until it calms down.
- All forms of retroactive punishment should be discontinued.
- All interaction between owner and dog must be initiated by the owner.
- Attention-seeking efforts by the dog should be ignored.
- Touching and playing with the dog are restricted to interaction on the command and initiative of the owner.
- Dog may sleep in the bedroom at the owner's initiative.

Departure procedures
- The dog is ignored for 30 minutes prior to departure.
- The dog is confined to the location where it must stay for the day 30 minutes prior to leaving.
- The dog is provided with toys and an object impregnated with the owner's scent.
- The owner is instructed to practice false departure routines in which preparations to leave are not followed by the owner actually leaving the house.

Other common treatment recommendations include graduated departures (Voith, 1980; Voith and Borchelt, 1985), involving progressively longer and more realistic departure exposures, muzzling the dog while the owner is away from home (Polin, 1992), and lengthy daily crate confinement (Takeuchi et al., 2000). Muzzling separation-reactive dogs is of questionable value and represents a significant risk of harm to such dogs (e.g., aspiration of vomit and heat exhaustion). Separation-distressed dogs become highly excited, and panting helps to regulate building body and brain temperatures. Restricting the dog's ability to pant may result in it overheating, with devastating results. Also, highly reactive dogs may become virtually obsessed with getting the muzzle off, possibly doing significant damage to themselves in the process. The so-called *denning* method involves the following stages of crate confinement (Takeuchi et al., 2000):

- The dog is confined to its crate continuously for 2 weeks, except for elimination, exercise, and obedience training.
- The dog is confined for an additional 2 weeks except when the owner is at home and awake.
- The dog is confined for an additional 2 weeks only when the owner is away.
- The crate door is left open at all times, permitting the dog to come and go as it pleases.

The use of crate confinement for treating SDS is fraught with dangers and raises a number of welfare concerns. Voith and Borchelt (1985) have criticized the use of crate confinement for treating separation-

related behavior as usually being counterproductive. In addition to persisting in the unwanted separation behavior, dogs confined in crates may severely injure themselves in an effort to escape confinement. When the crate is used, it should be introduced gradually and then faded out again as the dog's behavior improves, making every effort not to allow it to become a steel straitjacket (see *Adverse Effects of Excessive Confinement* in Chapter 2).

The methods used to treat SDS are often very restrictive and highly intrusive with respect to the human-dog relationship. Given the limited behavioral acumen of owners and questionable compliance patterns, it is hard to imagine that owners actual carry out some of the required treatment recommendations. In addition to complexity, procedures that intrude excessively upon the owner's ability to interact, play, and exchange affection with the dog spontaneously may simply be more aver-

TABLE. 4.2. Summary of separation procedures recommended by Podberscek et al. (1999)

Phase 1

Retroactive punishment is discontinued.

The dog is stopped from sitting on a lap or furniture when owner is nearby.

The dog is prevented access to the bedroom by baby gate first and then by closed door.

Gratuitous treats are discontinued.

Only the owner initiates interaction with the dog.

The dog's solicitations for attention are ignored.

Interaction between the owner and dog ceases 1 hour prior to departure.

When ready to depart, the owner waits an additional 10 to 15 minutes before leaving the house.

The dog is confined 20 to 30 minute before departure.

The dog is provided with clothing imbued with the owner's scent, given chew toys that are not otherwise available, tape recordings of owners voice are switched on, and the dog is ignored when the owner leaves the home.

Upon returning home, the owner should change clothing and wait 5 to 10 minutes before releasing the dog from confinement.

The dog's greeting behavior is ignored.

Phase 2

The dog is exposed to progressive and varying periods of separation from the owner while it is at home and awake.

The dog is separated by a door or gate (if separation by closing a door stresses the dog).

The dog is prevented from following the owner around the house.

The dog is prevented access to the upstairs (bedroom) during the day.

Phase 3

The dog is gradually removed from proximity to the bedroom at night and required to sleep in areas progressively closer to the area where the dog is confined during the day.

Phase 4

Predeparture cue desensitization and scrambling are used, e.g., picking up keys, putting on shoes or outdoor clothing, and setting burglar alarm, but not actually leaving the dog.

sive to the owner than the problem itself. In this regard, Takeuchi and colleagues (2000) found that more instructions were not necessarily associated with increased therapeutic benefit. In fact, owners given fewer than five instructions reported significantly better improvement in their dogs' behavior than owners given more than five instructions. Owner compliance was not a significant factor in the outcome of treatment. The significance of the study is hard to pin down, though, since owners who received more instruction may have presented a more severe and intractable problem in the first place. Nonetheless, a possibility exists that owners simply became progressively confused with more instructions or more inclined not to comply.

Aside from social intrusiveness, the implementation of common animal behavior-therapy procedures often involves significant changes in routine and restriction taking place over a very brief period. Stephens (1980) has suggested that abrupt changes in the direction of increased restriction or greater freedom may produce psychological stress, perhaps inclining some sensitive dogs to develop emotional and physiological disturbances. Dramatic loss of attention, contact, and freedom of movement may produce pronounced stress in already reactive separation-distressed dogs. Highly intrusive and restrictive methods of therapy may reduce undesirable behavior by generally shutting the dog down and thereby elaborating a generalized inhibitory state incompatible with separation-related excesses and distress: depression. The detachment process often recommended may not significantly alter a dog's attachment levels, as much as simply depressing the dog by the abrupt change in routine, social loss, and anxiety: previously predictable social interaction is suspended and replaced with physical and rule-based barriers designed to disrupt or prevent normal contact comfort and attention. The influence must certainly be destabilizing for highly attached and insecure dogs. To make therapeutic recommendations effective and humane, changes involving social loss and increased restriction should be implemented gradually and only after other less intrusive methods are carefully considered or tried. The keys to successful behavior therapy are simplicity and respect for the human-dog bond.

Crate Confinement

Despite the dangers and risks involved, crate confinement may prove to be a necessary part of the management of separation-distressed dogs, especially in cases involving destructive problems. Although increased anxiety or frustration may be initially evoked by the introduction of the crate, it is often an unavoidable part of the separation training process. The key here is to introduce the crate gradually together with the provision of comfort objects and appetizing toys over several days (see *Crate Training* in Chapter 2). Treats and toys can be put inside the crate in hopes of tempting the dog to explore it. In addition, the dog can be fed in front and later inside of the crate. In some cases, food is given to the dog only when the owner is about to leave, thereby compelling it to eat while alone and in the crate. Frozen rice balls containing turkey burger and kibble may be useful for this purpose. Rubber toys can also be stuffed with moist food and frozen.

Once the dog is entering the crate on its own accord, the door can be closed for brief periods while giving it treats from the outside. As the dog learns to accept crate confinement by freely entering it, a signal can be established to control the behavior (e.g., "Crate" followed by a hand movement similar to the one used to toss a treat inside the crate). Next, the dog should learn to enter and lie down in the crate for varying lengths of time. These initial exposures to crate confinement should involve a close association with the owner. The owner may lie down next to the dog while it is crated and periodically pet or feed the dog treats. These initial nonexclusionary exposures to crate confinement help the dog to form a positive place attachment toward the crate. As training progresses, the crate will gradually become a place of security and crate confinement a safety signal predicting the owner's eventual return. The crate also offers an effective response-prevention strategy in which the undesirable destructive behavior is blocked while other counterconditioning efforts are carried out. Once the dog becomes

better adapted to being left alone and the risk of destructiveness is reduced, crate confinement can be gradually faded out and the dog given more freedom to move about in the safe room.

The air-pump odor dispenser and feeder described in Chapter 3 (see *Systematic Desensitization*, Figure 3.5) can also be used to facilitate planned-departure training in separation-reactive dogs. The air pump can be used to deliver odor only or food only by clamping the tubing at appropriate points. Food-only delivery can be accomplished by completely closing the three-way valve. A remote switch can be used for remote activation. The presentation of the odor (e.g., orange or lemon-orange mixture) with safe departures and returns of the owner will gradually cause it to become an OSS. When the dog must be left alone for periods that exceeds its tolerance and is likely to result in high levels of distress, the odor should not be presented. The odor should only be used to overlap safe departures. Positive associations can also be formed between the odor and the presentation of food that may be useful for facilitating more relaxed and contented behavior. Perhaps, in the future, inexpensive timers will be available that can be used to turn on the pump periodically for brief and variable periods of time during the day to deliver the conditioned odor and food. Dilute odors such as lavender and chamomile may exert unconditioned mood-enhancing effects when delivered by diffuser.

Graduated Departures and Separation Distress

Many separation problems can be worked out without crate confinement, but usually some room or safe area (e.g., pen) is selected where the dog can be kept when left alone. In some cases, however, the crate may provide a secure place attachment from which to organize separation-related treatment activities. Before staging actual departures, the dog is first exposed to a series of planned-departure rehearsals while confined or crated in a separate room and the owner waiting in another part of the house. The room chosen for this purpose should be the same one used for confinement purposes when the dog is left alone during the day. Usually, a bedroom or kitchen is selected for such purposes, mainly because the dog has probably already formed significant place attachments or other positive associations with those areas. Both places appear to evoke strong and beneficial contextual effects. The bedroom, for example, may elicit relaxation and other effects associated with sleep, while the kitchen may be associated with a number of social and appetitive interests for the dog. The room is provided with a rug or blanket, a towel scented with the owner's odor, and other accoutrements to create a safe, comfortable, and relaxing ambience. Isolating a separation-reactive dog in a remote part of the house (e.g., the basement or garage) or outside on a chain is not only counterproductive, but may be dangerous and should be avoided. During rehearsal departures, the dog is left in the safe room for progressively longer periods, as determined by its tolerance and ability to cope with separation. It is important to keep these programmed separations brief enough to prevent the dog from becoming overly distressed or frustrated. Responding to the dog at such times by releasing it or attempting to calm it should also be carefully avoided. Frustrative persistence can be maintained on a surprisingly lean schedule of reinforcement. On the other hand, allowing the dog to persist in demanding barking or frenetic efforts to escape confinement is also inappropriate.

Barking behavior can often be interrupted with a squeaker followed by a click and treat when the dog defers its attention. Subsequent rewards are delivered in accordance with a DRO schedule such that the reward is produced only if barking does not occur during some brief period (2, 3, 10, 5, 7, 3, 5, 8, 15 seconds, and so forth on a variable basis). The only requirement put on the dog is that it not bark during the no-bark period. Alternatively, the barking behavior can be brought under stimulus control before off-cue barking is extinguished in accordance with instructions discussed in Chapter 5 (see *Barking*). If barking occurs, "Quiet," the vocal signal discriminating the no-bark contingency, is introduced or a firm "Enough" is spoken in a sharp and clipped manner, if a stronger impression is

needed. Again, at brief intervals, the dog is prompted to "Speak" and rewarded. The procedure is repeated many times in order to establish the necessary associative linkages. However, if despite such efforts the dog continues to bark, it may be necessary to employ a disrupter-type event or startle technique to stop the behavior from escalating (see *Guidelines for Successful Crate Training: Step 3* in Chapter 2).

Although many more or less sophisticated procedures can be employed for this purpose (e.g., a remote-activated citronella collar), the most simple and effective tool is a shaker can. The following recommendations assume that the dog has been habituated to the crate or safe room and that the undesirable behavior is likely driven by frustration. The shaker can (see *Miscellaneous Items* in Chapter 1) is introduced by tossing it near the dog while it is barking or attempting to escape confinement. The startling experience will sensitize the dog to the sound of the can, making its rattle an effective disruptive stimulus. Punishment of this sort briefly disrupts and inhibits the barking pattern so that the owner can return and positively reinforce more appropriate behavior. If allowed to bark, many dogs appear to become progressively distressed as the barking continues, but may immediately show signs of relaxation and contentment soon after an effective startle deterrent is applied. The disruptive startle elicited by the shaker can interrupts the cycle of increased arousal and demanding behavior, thereby allowing the owner to reward more cooperative behavior. Some separation-related barking that occurs when the owner is out of sight or outside of the house can be controlled by connecting an inexpensive remote-activated switch to an alarm, radio, or cassette player with a recorded message left on it. The remote switch provides an effective means to disrupt the undesirable behavior without requiring that the owner return to the dog while it is still barking—a potentially highly reinforcing event for a separation-frustrated dog. When the dog stops barking, the owner can return to the dog and reinforce quiet waiting behavior. Ideally, however, programmed separations should progress so gradually that the dog is not unnecessarily challenged or distressed, but if it does become reactive, the shaker can provides an expedient source of inhibitory control. In balance, allowing a dog to bark at such times may be much more stressful than the inhibitory effects produced by the sound of a shaker can or other moderate deterrents, as necessary to establish control (see *Separation-related Problems and Punishment*).

Once the dog is accepting brief periods of separation without signs of distress, safety stimuli such as a radio, light, or odorant can be introduced. For many dogs, the sound of a radio appears to offer some comfort prior to explicit conditioning efforts, perhaps stemming from an association of such stimulation with the presence of the owner. For some dogs, the television is particularly effective, especially in cases where the owner spends more time watching TV than listening to the radio. However, to obtain maximum benefit of safety signals, they should be systematically associated with minimally stressful separations and returns. The radio and light should be turned on just before the owner leaves the room and turned off just before the dog is released from confinement. A tape recording composed of everyday sounds and activities, such as the owner speaking on the telephone, washing dishes, watching television, vacuuming, or whatever else the owner might do while at home, might be made and turned on during departures. The safety tape is played on a continuous loop behind the door or otherwise out of the dog's sight, both during planned departures and when the dog is left alone for longer periods. During planned departures, the dog is given an especially desirable chew toy, such as a hard-rubber toy smeared on the inside with peanut butter or baby food (creamed meats) and stuffed with a biscuit. A nylon bone with several holes drilled into it can be stuffed with hard cheese or other canine delicacies. Such items offer an appetizing diversion for some dogs; however, other dogs seem to prefer the contact comfort of a soft item like a stuffed animal or towel saturated with the owner's smell. In addition to showing a preference for soft toys and cloth items, some evidence suggests that a mirror can provide relief against separation distress (Pettijohn et al., 1977). The

mirror is securely fastened to a wall adjacent to the crate.

A session of planned-departure training involves several trials consisting of graduated and variable durations of separation. A sample session might include the following variable duration (VD) exposures to separation: 5, 45, 10, 60, 20, 30, 45, 5, 120, and 50 seconds (VD, 39 seconds). Care should be taken not to progress too quickly or abruptly from one step to the next, since excessive separation exposure might intensify a dog's distress rather than help to reduce it. Notice that the progression is not a linear one, but varied so that the dog is unable to make any definite predictions about when the owner is likely to return; it only knows that the owner will eventually return after some variable period of separation. From a cognitive-emotional perspective, the aforementioned pattern of exposure results in varying degrees of surprise (the owner returns sooner than expected) and disappointment (the owner returns later than expected), but, ultimately, the owner does return. The combined effect of planned departures is to replace despair and loss at separation with hope, with the dog learning that patient waiting results in the eventual return of the owner. The expectant anticipation of the owner's eventual return appears to compete with adverse separation distress and frustration. For example, it has often been noted that many separation-reactive dogs are not apparently distressed when left in a car. Such dogs appear to have learned that calmly waiting for the owner's return eventually pays off. Apparently, the intermittent schedule of the owner's departures and returns to the car are sufficiently brief, frequent, and variable to facilitate a state conducive to separation security. Such dogs have learned to expect that their owners will eventually return and are comforted during periods of separation by a sense of hopefulness or positive anticipation about their owners' eventual return.

The time between exposure trials (intertrial interval) also appears to be an important variable. During the early stages of training, when very brief and unstressful separation exposures occur under the counterconditioning influence of an attractive or appetitive stimulus, the influence of the intertrial interval may not be significant. However, separation exposures involving durations of a minute or longer may require a more lengthy recovery period between separation-exposure trials. The recommended interval between trials of separation exposure ranges between 1 and 3 minutes, depending on the dog's response.

The success of planned departures is not based solely on the absence of separation distress, but also depends on before-and-after separation behavior. Ideally, the dog should gradually accept separation exposures without showing evidence of worry or other efforts aimed at forestalling separation. During actual departures, the dog should be given 5 to 10 minutes of basic obedience training and confined at least 15 or 20 minutes before the owner leaves, with the owner periodically returning to the confinement area to give the dog a treat. In some cases, massage and the presentation of a conditioned olfactory stimulus can be very beneficial as transitional aids to help reduce excessive arousal before departures and after homecomings (see *Taction and Olfactory Conditioning*). To forestall excessive greeting activity, a dog can be trained for a minute or 2 while remaining in the crate, requiring that it orient and attend briefly before bridging and rewarding the behavior. As the dog becomes more focused and calm, it is released and the training activity is continued outside of the crate for additional 5 to 10 minutes. Appetitive arousal produced by conditioned reinforcers and food appears to help restrain social arousal, perhaps by means of an oxytocin-mediated calming effect occurring in response to food reinforcement and social rewards (see *Origin of Reactive versus Adaptive Coping Styles*).

Counterconditioning Predeparture Cues

As already noted, separation-reactive dogs may show pronounced signs of rising apprehension whenever the owner prepares to leave the house. Such anticipatory arousal is the result of the dog recognizing a predictive relationship between certain of the owner's habits and separation. These predeparture activities (putting on shoes, picking up keys, and similar things) motivationally prime a dog to exhibit various comfort-seeking or separation-

delaying behaviors. In addition to setting the occasion for such behavior, if the behavior happens to be even marginally effective at forestalling the separation event, the underlying motivational arousal present at the time makes it certain that the behavior will undergo marked reinforcement. At such times, any efforts by the owner to calm or to compensate the dog otherwise for the impending separation will likely result in an increase in undesirable preseparation behavior. In addition, this anticipatory arousal to impending separation sets into motion the preliminary conditions for the expression of more intense separation distress or panic when the owner actually leaves the house.

Essentially, predeparture cues are conditioned stimuli that elicit preparatory emotional arousal in anticipation of heightened distress and panic that usually ensue whenever the dog is exposed to separation. Preseparation arousal and activities involve complex operant-respondent interactions. Consequently, the process of changing the associative, behavioral, and motivational implications of predeparture stimuli involves the use of both instrumental shaping and classical counterconditioning techniques. Predeparture cues are counterconditioned in various ways:

- *Engage the dog in some highly attractive activity while simultaneously exposing it to predeparture rituals.* One way to do this to give the dog an appetizing chew item that will occupy it while pretending to get ready to leave.
- *Explicitly pair predeparture cues with antagonistic attractive or appetitive stimuli.* In this case, items such as keys or a briefcase are picked up and immediately followed by giving the dog a food treat. Another situation might be staged where the owner picks up car keys and umbrella only to sit down again, tossing the incredulous dog a treat. Another possibility involves the owner putting on work clothes before feeding the dog. Other possibilities include picking up a briefcase or performing some other predeparture sequence and surprising the dog by taking it for a walk, initiating a brief play session with a favorite toy or ball, or massage.
- *Condition predeparture cues as discriminative stimuli for cooperative behavior.* The owner puts shoes and coat on and then has the dog lie down and stay for several minutes while periodically receiving treats. At other times, a session of basic training could be carried out.
- *Extinguish aversive associations by repeatedly performing predeparture sequences without actually leaving home.* For example, the owner periodically picks up keys only to put them back down again. A variety of predeparture sequences are initiated and concluded without the owner leaving the house. The overall effect is to scramble associations so thoroughly with regard to predeparture activities that the dog is unable to predict when separation is likely to occur. *Note:* Scrambling predeparture cues may help to dissociate them from the actual departure event, but some separation-anxious dogs may become significantly worse as the result of the scrambling procedure. In such dogs, scrambling may raise anxiety levels by decreasing the dog's ability to predict when the owner will leave the house, appearing to cause them to become more vigilant for the event. Many dogs showing separation distress with anxiety or panic appear to do better if predeparture cues are left unscrambled.
- *Shape more appropriate behavior occurring in the presence of evocative predeparture cues.* After putting on work clothes, the owner systematically reinforces behavior such as turning away or laying down.

In general, the goal of these procedures is to alter the dog's expectations about the significance of preseparation events or to reinforce more appropriate preseparation behavior.

Practical Limitations and Compliance Issues

Performing graduated departures and counterconditioning or scrambling predeparture cues appears to be effective, but the precise value of these procedures for the control of SDS is not known. Although most dog behavior therapists seem to agree that graduated departure training

is beneficial, some have criticized the complexity and difficulty of the method for the average dog owner to implement. The success of graduated departure training depends on highly controlled circumstances of exposure and diligent owners willing to commit the necessary time to make the process work. The biggest obstacle is ensuring that the dog is not left alone for too long during the treatment program—a commitment that can last several weeks. Although some dedicated dog owners can find time to carry out planned departures while at home in the evening or on weekends, they must inevitably leave the dog alone. In principle, lengthy exposures to separation should adversely impact the positive gains achieved by desensitization efforts.

Several methods might be considered to address this difficulty. The owner might be fortunate enough to find a neighbor or friend with whom the dog can stay for the first few days or weeks of training. Another method involves hiring a dog walker to carry out graduated departures after the owner leaves for the day. Finally, the owner might borrow a friend's dog (perhaps also left alone during the day), which the resident dog knows and likes, to stay with the distressed dog on a trial basis. Although such an arrangement may sometimes work (Houpt, 1979), it often does not (Voith and Borchelt, 1985) and may be highly stressful for the visiting dog. The arrangement should be discontinued if the distressed dog continues to exhibit a high degree of separation distress. In some cases, the owner might be able to take the dog to work temporarily, but this option does little to improve the dog's behavior when it must be left alone at home. Other options include kenneling or dog day care. Lastly, various medications may be considered as a temporary means to control excessive distress, especially if the dog must be left alone while undergoing desensitization (Voith and Borchelt, 1985).

Quality of Social Attachment and Detachment Training

Attachment and Detachment

The difficulties associated with the graduated departure procedure have prompted the development of techniques designed to alter attachment levels via the implementation of interactive stressors (e.g., ignoring care-seeking behavior, refusing the dog physical contact, removing the dog from the bedroom, and continuous crate confinement). Detachment procedures are premised on the belief that SDS is the result of a dog's poorly regulated attachment behavior. Presumably, as the result of excessive and unregulated social contact, the dog becomes exceedingly and problematically attached to the owner, making separations evocative of disruptive distress and a gradual breakdown of the dog's ability to cope at separation. According to this view, the amount of distress shown by the dog at separation is proportional to the degree of attachment between the dog and the owner.

The significance of attachment levels and proximity seeking in the etiology of adult separation distress has been questioned by various authors [Voith et al., 1997; Goodloe and Borchelt, 1998 (see *Attachment, Proximity Seeking, and Family Size* in Volume 2, Chapter 4)]. In addition, Bradshaw and colleagues (2002) failed to detect any relationship between the amount of owner-dog interaction and the probability of separation-related behavior from month 3 to month 18, further questioning the attachment hypothesis. These reports suggest that it is not a dog's overt attachment or the amount of interaction between the owner and dog that underlies separation-related problems, but rather the way in which the dog copes with being left alone. Most dogs develop strong attachments toward their owners, but only a small percentage of them go on to exhibit clinical separation distress. Many separation-reactive dogs are quite content at separation so long as some human is nearby, even someone with whom the dog has not formed a particularly strong attachment.

The attachment hypothesis appears to confuse effects with causes. Attachment excesses may follow more directly as the result of agitation and distress at separation and a compromised capacity for coping with stress adaptively (see *Origin of Reactive versus Adaptive Coping Styles*), rather than as the result of unregulated affiliative interaction between the dog and owner. The daily agita-

tion and distress at separation followed by relief by the owner's return probably results in the evident contact-seeking behavior exhibited by separation-reactive dogs. In other words, separation-reactive dogs may follow their owners around and seek contact, not because of unregulated affiliation, but rather because of a history of unregulated separation distress and agitation. According to this view, excessive attachment is not the cause of separation distress; on the contrary, excessive attachment is more likely the result of heightened agitation and distress at separation. Consequently, the arbitrary reduction of proximity seeking and attachment behavior between the owner and dog may not serve to alter significantly the causes of separation reactivity and dysregulation, but may instead inadvertently increase social contact needs and problematic attachment behavior. Consequently, detachment procedures and interactive stressors aimed at reducing contact and attachment behavior may inadvertently increase attachment levels via the emotional agitation, frustration, and insecurity produced by the detachment procedure itself, many components of which are highly punitive and restrictive with regard to a dog's social initiatives. The use of interactive stressors to modify attachment behavior is contrary to the enhancement of social competency, confidence building (intrinsic counterconditioning by relaxation), and reward-based stress modulation via enhanced comfort and safety-security. Ultimately, the best way to reduce excessive and insecure attachment behavior is not by arbitrarily implementing interactive stressors designed to unilaterally limit contact between the dog and the owner, but rather by reducing the amount of agitation and distress the dog experiences at separation, while at the same time training it to respond more adaptively to stressful situations, and, most importantly, improving the quality of the social bond between the owner and dog—not weakening or dismantling it.

Despite some disagreement on the matter of how attachment levels influence the development of SDS, evidence suggests that close and exclusive attachments probably do play a significant role in the etiology of some separation-related problems (see *Attachment, Proximity Seeking, and Family Size* in Volume 2, Chapter 4). Dogs exhibiting a strong attachment toward a particular family member appear to be at an increased risk of developing separation problems (McBride et al., 1995). Topál and colleagues (1998) found that dogs living in large family groups exhibit less separation distress when tested than dogs coming from families with fewer members. Data from a clinical population indicated that most separation-reactive dogs live in small family groups containing two adults and no children (Podberscek et al., 1999). Flannigan and Dodman (2001) have confirmed that family size is a significant risk factor associated with separation-related behavior problems, finding that dogs kept by a single owner are 2.5 times more likely to exhibit separation problems—a risk factor previously missed (McBride et al., 1995). Surprisingly, the presence of another dog in the household does not appear to reduce the risk of separation problems (Flannigan and Dodman, 2001). This finding seems odd since dogs generally appear to cope better with separation when living with another dog or cat. As already discussed, the presence of another dog does not ensure that canine company will comfort an already separation-distressed dog, but one would expect some preventive benefit as the result of the formation of bonds with other animals in the household. Nonetheless, consistent with the findings of Flannigan and Dodman, McBride and colleagues (1995) also found that the incidence of separation-related problems among dogs adopted from an animal shelter was not significantly related to the presence of another dog in the new home. Dogs placed in homes with at least one cat, though, were less likely to exhibit separation-related problems—a curious finding needing additional study.

In a sense, many treatment protocols seem to have misidentified the social symptoms of SDS as the causes of the problem. Although modifying and managing symptoms may exert some beneficial influence, whenever possible treatment efforts should focus on primary causes—not effects and symptoms. Unless agitation and distress at separation are

reduced, heightened levels of attachment and contact needs will probably continue unabated, perhaps worsening as the result of implementing intrusive detachment procedures (Table 4.3).

Detachment training may be transitionally useful in some cases involving extreme attachment disorganization, but the necessity of interactive stressors to reduce separation-related problems has not been scientifically established. Further, there is no significant evidence supporting the belief that spoiling activities or permissiveness with respect to attachment behaviors (e.g., sleeping on the bed) are causally related to separation-related problems (see Flannigan and Dodman, 2001; and Voith et al., 1992). Also, the common belief that excessive fussing during departures and greetings is causally related to separation problems is not supported by the current data (McBride et al., 1995). For highly attached dogs, the introduction of detachment training may introduce additional conflict and confusion, resulting in further disruption and distress at separation, perhaps making matters worse and the problem more difficult to resolve in some cases. In general, the key is not to detach the dog from the owner arbitrarily and unilaterally, and possibly further undermine its social confidence and make the relationship more unstable and the dog more reactive, but to enhance the bond between the owner and dog through training. The dog's need for contact and proximity can be directed into constructive training activities that support interactive harmony, enhanced confidence, and social independence. Rather than emphasizing detachment training as a way of life, behavioral efforts are much better dedicated to independence training, whereby the dog learns to cope more competently and confidently with separation and aloneness (see *Cynopraxis and the Human-Dog Bond* in Volume 1, Chapter 10). Finally, detachment procedures are often highly intrusive, perhaps being more aversive to some owners to carry out than coping with a dog's separation problems. Consequently, even in the event that detachment procedures work, it is unlikely that the owner will want to indefinitely maintain the interaction needed to support the detachment effect.

Dynamics of Bonding: Nurturance, Dominance, and Leadership

Since the quality of attachment and bonding (mutual ties) between the owner and dog appears to play a prominent role in the development of SDS, it makes sense to build on the dog's affection and attachment, taking what one finds and guiding it into a more healthy and mutually satisfying form. In other words, treatment should focus on repairing disorganized aspects of attachment behavior, rather than suppress and impede attachment behavior in general. The relationship between humans and dogs is formed under the influence of three fundamental and complementary bonds that dynamically interact with one another: (1) nurturer-dependent bond, (2) dominant-subordinate bond, and (3) leader-follower bond. Note that each bond consists of two modes of

TABLE. 4.3. Summary of common detachment procedures

The owner must ignore all of the dog's social solicitations for contact.
Proximity-seeking behavior is discouraged by command or confinement.
The dog is separated for progressively longer periods while the owner is at home.
The dog is forbidden from sitting on the owner's lap or to share furniture.
The dog is not permitted to sleep or be in the bedroom at night.
The dog must earn all appetitive and social rewards.
The dog's greeting behavior is ignored or discouraged.

mutual reciprocation by which the owner and the dog relate to each other. A healthy human-dog relationship is based on a balance of nurturance and dependency, dominance and submission, and leadership and cooperation. Inadequacies or excesses in any of these three basic binary dimensions of social interaction may cause disharmony and disturbance in the social relations between people and dogs.

A common source of confusion is distinguishing between dominance and leadership. Many authors seem to treat dominance and leadership as synonyms meaning approximately the same thing. Dominance-related interaction involving covert, subtle, or overt threats of force or the use of actual force of varying degrees (e.g., holding the dog back from some activity or shoving it off as it jumps up) and submissive acknowledgment by the dog serve to set social limits and define what a dog cannot do. The effect of submission is primarily inhibitory, causing a dog to avoid certain behaviors, at least while in the owner's presence, but without specifying what the dog ought to do instead. Dominant-subordinate interaction involves overt contests or threat-appeasement displays, activities that appear to enhance affectionate tolerance (dominant role) and affectionate attraction (subordinate role). Affection arising from dominant-subordinate interaction causes the subordinate paradoxically to seek closer proximity with the dominator (see *Social Distance and Polarity* in Volume 2, Chapter 8). Attention seeking and proximity seeking reflect a highly submissive and inhibited orientation in which the dependent subordinate is looking for leadership and guidance—it literally needs to be shown what to do. The direction of social interaction between the dominator and the subordinate is highly directional or polarized. Social polarity is manifested in care-seeking activities, such as attention-seeking, affection-seeking, and proximity-seeking behavior. The establishment of dominant-subordinate relations prepares the subordinate to become a dependent and cooperative follower if adequate leadership is provided. However, a highly submissive dog, in the absence of leadership, may be vulnerable to develop insecure attachment, especially if the dominator is primarily a source of nurturance and fails to *own* the responsibility of leadership. Social dominance without leadership is a formula for behavioral and emotional imbalance and insecurity, potentially giving rise to extremes of abusive domination, on the one hand, and careless indulgence, on the other.

Whereas transactions involving the exchange of threat and appeasement displays establish that certain behaviors are forbidden, leadership helps to guide the dependent subordinate into activities that are acceptable and lead to various sources of appetitive and social gratification. Leadership is associated with the initiation and coordination of cooperative activities that result in benefit for both the leader and the follower. Whereas submission exerts an inhibitory influence, following provides an excitatory influence on behavior. The result of dominance is submission, affection, and dependency, whereas leadership provides the basis for social cooperation and interactive harmony. With respect to the human-dog bond, it would seem that excessive proximity seeking and affection seeking are not symptoms of attachment excess, but reflect a submissive and dependent search for leadership. The relation between dominance, leadership, and nurturance is reflected in the moment-to-moment ebb and flow of social interaction, defining what is not done, what is done, and the sorts of appetitive and affectionate gratifications that accrue as the result of cooperative and harmonious interaction. The process of obedience training incorporates all three dimensions of the bonding triune in a balanced relationship. Basic training defines what a dog may not do (e.g., jump up, bite on hands and clothes, and pull on the leash), shows the dog what it may do (jump up on signal, play tug and retrieve, controlled-leash walking, sit, stay, come, and so forth), and provides contingent nurturance (e.g., affectionate petting and food) based on cooperative behavior.

Owners of separation-distressed dogs need some specific things to do, but more importantly they need principles (more than rules and recipes) to guide their daily interactions with the dog. Having a separation-distressed dog perform repetitive sit-stay exercises and other unilateral and arbitrary detachment initiatives (rejection of attention and contact, blocking of proximity seeking, and cessation of noncontingent affection and rewards) may fully miss the point unless the owner is led to a better appreciation of the dynamic interplay between dominance, leadership, and nurturance in the process of balanced and healthy bonding. An important step in this direction is to teach owners to appreciate their dog's behavior as form of communication needing thoughtful interpretation and understanding.

BASIC TRAINING AND SEPARATION DISTRESS

One of the best ways to restore appropriate limits and balance to the human-dog relationship is basic training. Not surprisingly, obedience training has been correlated with a reduced incidence of separation-related complaints (Goodloe and Borchelt, 1998; Jagoe and Serpell, 1996; Flannigan and Dodman, 2001), possibly as the result of organized attachment behavior and the enhanced confidence promoted by obedience training. Clark and Boyer (1993), also noting that obedience training appears to have a pronounced effect on separation-related behavior problems, speculate that obedience-trained dogs appear to be more secure in their attachments—a security that may be the result of enhanced owner-dog communication and interaction. Dogs without a viable channel of communication may be unable to relate to the owner as an independent affiliative partner, a failing that may predispose it to develop a persistent and regressive reliance on direct contact and vulnerability at separation:

> Ainsworth (1972) found that separation distress becomes less significant as children become better able to sustain attachment in abstentia and that close proximity and contact may, to some extent, be supplanted by communication and interaction across a distance. Thus obedience training may be the communication tool for the owner to provide security in the relationship and improve the human-canine relationship. Obedience training may facilitate feelings of security for dogs, because training communicates proper behavior by reinforcing appropriate behavior and punishing inappropriate behaviour. (157)

In addition to preventing or reversing problematic dependency and enhancing an owner's leadership, basic training improves a dog's attentional and impulse-control abilities—two vital cortical executive functions necessary for effective adaptation under stress. Most importantly, though, for purposes of separation-distress problems, no other activity improves a dog's confidence and sense of security better than basic training. Training activity should be integrated into the everyday interaction between the owner and dog. A "no pay, no play" philosophy may be instituted in which the dog learns that attention and affection are earned most effectively by cooperative behavior. The heightened social contact needs associated with homecomings should be harnessed to the furtherance of training objectives (see *Establishing Operations* in Chapter 1). At such times, dogs are acutely sensitive to petting and praise as rewards. Instead of ignoring or simply giving a dog the attention and contact stimulation that it craves, a cycle of basic training exercises can be performed in exchange for social and appetitive rewards. Because all dogs, like people, are different and require training designed to meet their specific needs, basic training is best carried out under the supervision of an applied dog behaviorist or a skilled trainer familiar with the needs of the separation-reactive dog.

Although basic training may not directly modify separation distress or frustration, it offers a useful and proven means for clarifying social boundaries and establishing general control that may be extremely beneficial. Takeuchi and colleagues (2001) found that owners with separation-anxious dogs tended to indulge them and used verbal discipline rather than physical means to control undesirable behavior. Separation-reactive dogs are often very skilled at getting their way by emotionally or physically manipulating their owner. These tactics and schemes may entrap

a naive owner in a subtle web of obligatory expectations and emotional pressures to concede to the dog's demands. Having maneuvered into a position of emotional leverage over the owner, the dog may find it extremely difficult to cope with situations where its control is compromised or forfeited, as occurs at separation. A dog that is accustomed to getting and controlling the owner's attention and proximity on demand may be more prone to become frustrated when the behavior fails to work, as occurs when the owner must leave the dog alone. Under the influence of frustration and secondary distress at separation, separation-reactive dogs may exhibit and intensify protest behaviors that have succeeded in past to get the owner's attention (e.g., barking, scratching on doors, or grabbing personal belongings).

From an early age onward, dogs may learn that certain undesirable behaviors are a sure way to get attention, albeit not always the most desirable attention. For some dogs, the preponderance of the daily interaction and attention received during puppyhood may have been primarily obtained by way of disciplinary interaction directed at suppressing such problematic attention-seeking behavior. Many of these behaviors are similar to the array of protest behaviors occurring at separation. As previously discussed, punitive interaction may potentiate dependency and attachment behavior in dogs (see *Early Trauma and the Development of Behavior Problems* in Volume 2, Chapter 2). Faced with separation frustration and distress, dogs may resort to those same behaviors that have worked in the past to protest and get the owner's attention. Retroactive punishment (punishment directed against past deeds), which is common in the case of separation-reactive dogs (see *Separation Distress and Retroactive Punishment* in Volume 2, Chapter 4), is highly undesirable and problematic, appearing to increase the dog's dependency and vulnerability to emotional distress at separation, potentially setting into action a vicious cycle of punishment and increased separation-related reactivity. Since retroactive punishment is relatively unpredictable and uncontrollable, it may impair the dog's ability to trust the owner as a source of safety and consistency, leading in extreme cases to significant cognitive and emotional disorganization.

Separation-related Problems and Punishment

Separation distress is potentiated by a number of coactive motivational and emotional influences, especially frustration, boredom, fear, and panic. The role of these various contributing motivational influences in the expression of separation-related behavior should be carefully assessed before considering the use of punishment. Obviously, punishment would be an entirely inappropriate option in the case of highly unstable and reactive dogs. Also, it must be emphasized that punishment may worsen some separation-related problems, especially those presenting under the influence of panic, making the use of punishment risky and requiring careful monitoring. As mentioned previously, inappropriate or excessive punitive treatment may paradoxically enhance attachment behavior and risk increasing separation-related problems. Further, without appropriate support conditioning aimed at reducing the dog's aversive emotional response to separation, a possibility exists that the dog, unable to find relief in its preferred modality, may redirect its distress-reducing impulses into other, perhaps even more undesirable and difficult-to-control, activities. Despite significant concerns and reservations, some forms of separation-related behavior, especially barking problems and destructiveness resulting from protest at separation, appear to be highly responsive to certain punitive procedures. Although the method is not popular with some and despite some authoritative opinions to the contrary, separation-related barking is often highly responsive to aversive treatment procedures involving the use of bark-activated collar devices. Barking problems may require timely intervention and modification, with the owner facing imminent eviction or costly nuisance citations. Many owners who have independently resorted to the use of bark-activated collars to treat such behaviors have reported a high degree of success. The use of bark-activated collars to suppress barking is risky and can result in disaster in the case of

panic-related separation problems, which appear to escalate dramatically under the excitatory influence of fear (see *ES and Excessive Barking* in Chapter 9). Although crating or penning a dog can control destructive habits temporarily, eventually the dog is released from confinement and exposed to at least part of the house. Giving such a dog increased freedom and comfort may result in undesirable exploration and destructive behavior. Various techniques involving repellents, booby traps, and electronic devices are used selectively to prevent or suppress such behavior in the owner's absence. The details of these various procedures are described in Chapter 2 (see *Miscellaneous Devices and Techniques for Deterring Destructive Behavior*).

MASSAGE, PLAY, AND EXERCISE

Taction and Olfactory Conditioning

Massage and relaxation training have many applications in the management of dog behavior, especially in situations involving aversive emotional arousal such as separation distress (Tuber, 1986). The first systematic effort to quantify the calming effect of human taction on dogs was performed by Gantt and colleagues (1966), who observed that many dogs in distress are calmed by social contact, exhibiting a significant decrease in both heart and respiratory rates while being petted. The authors referred to this phenomenon as the *effect of person* (see *The Effect of Person* in Volume 1, Chapter 10).

In conjunction with tactile stimulation, olfactory stimulation appears to play a significant role in the formation of social attachments and bonds (see *Biological and Social Functions of Smell* in Volume 1, Chapter 4). Among rat pups, odors appear to facilitate huddling behavior, with olfactory incentives developmentally supplanting thermal and tactile ones in the regulation of such behavior (Rosenblatt, 1983). Unfortunately, the full emotional significance and value of the sense of smell for dogs remain elusive and conjectural. There is little doubt that olfaction plays an important role in emotional learning and attachment (see *Social Comfort Seeking and Distress* in Volume 2, Chapter 4). The social significance of olfactory information is highly durable in dogs. They exhibit evidence of recognizing the scent of the mother and the breeder after years of separation, social memories that may persist throughout a dog's life cycle (Hepper, 1994; Appel et al., 1999). By way of limbic system projections, olfactory information may exert significant conditioned and unconditioned effects involving various neuropeptide systems (e.g., opioid, oxytocin, and AVP) believed to play a role in the expression of social emotions and memories. As the result of direct connections with the amygdala, strong links between olfaction and social aversion may be established. The amygdala plays a central role in fear learning and exercises a powerful modulatory influence over the expression of fear via connections with hypothalamic nuclei dedicated to elaboration of fear, startle, and stress responses (see *Limbic System* in Volume 1, Chapter 3). Olfactory stimulation is easily and rapidly conditioned to produce emotional alarm. Through interconnections with the amygdala (emotional memory) and hippocampus (contextual memory), olfactory learning may exert a significant conditioned influence over the release of CRF and the cascade of events associated with biological stress. In addition to these subcortical influences, olfaction reaches cortical representation through interconnections among the amygdala, the hippocampus, the thalamus, and the prefrontal cortex, where the information is further processed, accessed by the working memory, and coordinated with goal-directed activities. The role of olfaction at the level of cognition has received very little attention in dogs, but in rodents there is growing evidence to suggest that they may "think" with their noses (Slotnick, 1994; Slotnick et al., 2000).

The canine olfactory system provides a powerful means to influence separation distress through conditioned associations with safety (relief), physical and emotional relaxation, appetitive stimuli, and play activities. Olfactory stimuli associated with predeparture activities appears to exert significant preparatory influences on a dog's emotional response to separation. Odors (e.g., the smell of coffee or the owner's cologne or deodorant) repeatedly present at departure may

become potent conditioned olfactory stressors, perhaps contributing significantly to a dog's reaction at separation. Like other conditioned predeparture stimuli, olfactory stressors need to be identified and counterconditioned whenever possible. On the other hand, olfactory stimuli associated with the owner homecomings may acquire potent conditioned relief and safety associations that can be used to counter agitation and distress associated with separations. The apparent efficacy of the owner's scent on towels and so forth to quell separation distress may be derived largely from olfactory conditioning that occurs during greetings. Putting on a scent used during safety conditioning and PFR training (e.g., orange or lemon-orange mix) just before entering the house to greet the dog or puppy after a long separation may help to intensify the effect of the odor as a conditioned source of security for the dog.

Massage is a useful way to calm a separation-reactive dog while performing graduated departures. Dogs that become overly aroused at departures and homecomings are often highly responsive to 3 to 5 minutes of PFR training just before the owner leaves and again after the owner returns home. The method used follows the guidelines and procedures described in Appendix C. Although not all dogs are equally responsive to massage, most appear to benefit from the experience. For many dogs, massage produces a pronounced and easily replicated relaxation response. In addition to the direct benefits of massage-induced relaxation, the focused and unambiguous contact comfort produced by massage may exert ancillary therapeutic benefit by modulating the production and release of neuropeptides (e.g., oxytocin, endogenous opioids, and CRF) involved in the mediation of contact comfort and separation distress. To capture the benefits of massage and optimize the ability to generalize the benefits across contexts, an olfactory stimulus is paired with massage-induced relaxation. Once conditioned, the odor can be used during graduated departures and predepartures as an OSS. Performing massage in the presence of other safety signals (e.g., music, radio, and light) can help to support and augment the effect of such signals. To help transfer and generalize the olfactory association, the owner can place a drop or two of the fragrant oil on the hands while carrying out planned departures.

Various odor diffusers are available that can be used to present the OSS over time. A diffuser is made by drilling two small holes into the cap of a small bottle and inserting rubber tubing into the holes, with one of the tubes (the outlet) extending to the vicinity of the crate and the other (the inlet) attached to the aquarium pump. The tubes should form an airtight seal with the lid. A dilute fragrant odor can be put on several cotton balls that are placed on top of the inlet tube or the odor can be diluted in water and released by a bubbling action. The outlet tube should be situated an inch or so below the lid so that it does not touch the water. A ceramic ring that is heated by a light bulb can also be used to diffuse fragrant oils. The dilute essential oil is simply dripped onto the ceramic ring before leaving the house. When graduated departure activities are performed, the light is switched on, thereby combining the effects of two safety signals in one action. Alternatively, a plug-in room freshener can be modified so that the conditioned OSS is released instead of the packaged odorant coming with the unit.

Play and Exercise

Play and exercise appear to exert a positive influence on the treatment of separation-related problems. Play offers a ready means to normalize the social interaction between the owner and dog, reduce stress, and enhance affiliation, confidence, cooperation, and emotional flexibility, thereby helping to harmonize human-dog interaction. Engaging the dog in object-oriented play (e.g., tug and fetch) also provides a source of highly enjoyable aerobic exercise. The provision of supplemental exercise may be particularly important in the case of active, working, or sporting-type dogs with separation-related problems. Exercise appears to exert a variety of neurobiological effects, including a robust influence on serotonergic activity (see *Exercise and the Neuroeconomy of Stress* in Volume 1, Chapter 3).

Separation-reactive dogs should be exercised daily. An excellent exercise plan incorporates a combination of long walks and playing fetch with a ball or soft disk. Walks as brief as 20 minutes or so can be very beneficial, but some dogs may require much more exercise to produce a benefit (Radosevich et al., 1989). The crucial consideration with regard to exercise is that it be provided on a consistent and daily basis. Exercise scheduled erratically or on impulse may result in additional problems. For example, taking the dog for a 5-mile walk 1 day, skipping 2 or 3 days, and then jogging the dog for a week, followed by a week without any exercise—this sort of pattern may be more stressful and tension producing than relaxing for the dog. The best rule of thumb is to provide the dog with adequate exercise, play, and training on a consistent basis every day.

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5

Compulsive and Hyperactive Excesses

PART 1: COMPULSIVE BEHAVIOR DISORDERS

Dogs exhibit a variety of compulsive behavior problems. Compulsions typically involve species-typical behavior patterns that are performed repetitively, excessively, and out of normal context. Many common compulsive habits appear to involve disturbances of the seeking system and the exaggeration of normal canine behavior, occurring under the influence of frustration, anxiety, and conflict, especially social conflict. Frustration of the seeking system caused by environmental constraints that thwart the animal's ability to explore, hunt, and obtain normal daily gratification of species-typical appetitive interests may prompt a variety of compensatory compulsive or adjunctive behavior excesses [e.g., schedule-induced licking (see *Displacement Activities and Compulsion* in Volume 2, Chapter 5)]. Self-directed stimulation and injurious behaviors (e.g., self-licking, chewing, scratching and sucking), self-directed motor stereotypies (e.g., tail chasing, whirling, and air snapping), appetitive compulsions (e.g., pica, excessive eating and drinking, destructive chewing, and floor licking), social excesses (attention seeking, barking, licking, and pawing), and locomotor excesses (pacing, jumping in place, and ground or carpet digging) can all be traced to origins in the seeking system. Behaviors belonging to the sexual system can be liberated to become compulsive excesses (e.g., mounting and thrusting on people or inanimate objects). Like tail chasing, mounting and thrusting behavior resists interruption and may in some cases evoke an aggressive response when dogs are restrained or interrupted while engaging in

the behavior. Such behavior may be directed against family members or guests despite intensive inhibitory training and castration. While not customarily described as a compulsion, such behavior presents with many characteristics consistent with a compulsive etiology. The displacement behavior is prevalent during social transitions, especially during greetings and departures, or at other times of increased excitement.

Dogs most prone to develop compulsive behavior problems are frequently high strung and impulsive, temperament dimensions that are exacerbated by adverse environmental conditions. Highly motivated and high-strung dogs that are intolerant of conflict and frustration seem to be particularly at risk for developing compulsive habits. Many dogs appear to exhibit compulsive behaviors at moments of high excitement, suggesting that in some cases compulsions may serve an energy-releasing function. Diagnostically, there is significant overlap between compulsive and impulsive behavior. Differentiating between the two is particularly difficult in the case of repetitive excessive behaviors exhibited by high-strung and excitable dogs. A similar diagnostic difficulty exists in the case of hyperactive versus hyperkinetic dogs (see *Hyperactivity versus Hyperkinesis* in Volume 2, Chapter 5). In general, compulsive behaviors are more exaggerated and resistant to behavior-control efforts than impulsive ones, but even here significant variation exists.

A number of phylogenetically significant behavior systems have been implicated in the development of compulsive stereotypies and rituals, including agonistic, territorial, predatory, grooming, locomotor, and social communication systems. Additionally, separation-related excesses often possess a compulsive character (e.g., repetitive and stereotypic vocal, oral, and motor activities), suggesting that the separation-distress syndrome may involve a similar etiology and functional disturbance (see *Compulsion* in Volume 2, Chapter 4). O'Farrell (1995) has reported evidence suggesting that some compulsive excesses may be linked to owner emotional attachment levels and anthropomorphic attitudes. Licking excesses frequently present in close association with separation-related distress and excessive confinement (Goldberger and Rapoport, 1991). Instrumental modules and modal activities performing agonistic or territorial functions may be compulsively activated under the influence of adverse social or environmental conditions. Tail-chasing behaviors may involve some degree of self-directed aggression (see *Vacuum Behavior* in Volume 2, Chapter 5), with such dogs frequently barking, growling, and snapping at their tails. Interrupting tail-chasing episodes or even standing nearby while one is ongoing may evoke redirected aggressive threats or attacks by the dog, further supporting the notion that an aggressive motivation may underlie the tail-chasing behavior. Among monkeys exposed to prolonged isolation, self-directed biting and head slapping are frequently observed. Jones and Barraclough (1978) have suggested that these compulsive and self-injurious behaviors may involve an aggressive motivation turned against the animal's body. Rapoport (1989) has observed that the checking rituals common to human patients with obsessive-compulsive disorder (OCD) may involve territorial subroutines dedicated to the maintenance of territorial boundaries and order. Recent studies appear to support the notion that territoriality may underlie human checking compulsions. Joiner and Sachs-Ericsson (2001) have detected a significant correlation between high territoriality scores and the severity of obsessive-compulsive symptoms. The excessive scent marking exhibited by some male dogs may reflect a compulsive exaggeration of a territorial module dedicated to checking and marking over urine deposits left behind by other male and female dogs. In some cases, sniffing and marking rituals may become so engrossing that other behaviors are largely displaced by its performance. Under adverse conditions, highly territorial dogs may develop a variety of compulsive excesses associated with the expression of exaggerated or maladaptive territorial subroutines (e.g., excessive barking and environmental vigilance).

Unable to engage in preferred activities, frustrated dogs may cope with the situation by compulsively engaging in alternative behaviors. In addition to conflict and frustration, stress and boredom appear to play a role

in the etiology of compulsive behavior (see *Conflict and Coactive Factors* in Volume 2, Chapter 5). Boredom as the result of insufficient stimulation may be less problematic than boredom resulting from the frustration of exploratory behavior and the reward derived from such activity (see *Separation Distress and Coactive Influences* in Volume 2, Chapter 4). In the case of highly active and unstable extraverts (choleric type), thwarting their ability to explore the environment freely may be intensely aversive. Among such dogs, repetitive compulsive actions may represent a diversion and a significant source of comfort and relief. Boredom in the case of more retiring and introverted types may be less problematic, although unstable introverts (melancholic types) that show anxiety and depressive symptoms at separation may be particularly prone to develop compulsive behaviors aimed at obtaining comfort via lingual stimulation. Dogs expressing relatively balanced and stable temperaments (sanguine and phlegmatic types) appear to be much less at risk for developing compulsive habits under ordinary conditions. These observations are consistent with the supposition that temperament plays a significant predisposing role in the etiology of compulsive behavior disorders (CBDs) in animals (Dallaire, 1993). Temperament also appears to play a prominent role in the development of OCD in humans. Human subjects diagnosed with OCD frequently exhibit comorbid anxiety, depression, and biogenetic temperament dimensions conducive to compulsive disorder, including strong harm-avoidance tendencies, reduced novelty seeking, and impairments in goal-directed activity. The variable presence or absence of these contributory influences significantly affects the severity of symptoms and the patient's response to pharmacological therapy (Lyoo et al., 2001).

Many canine compulsive behaviors appear to develop in close association with increased aversive arousal (e.g., anxiety and frustration) and concomitant physiological changes associated conflict-dense situations and stress. Disruptive behavioral changes are commonly associated with a lack or loss of prediction and control over the social or physical environment. The emotional corollaries of environmental unpredictability and uncontrollability are increased anxiety and frustration. In cases where the environment is disordered, adaptive efforts are stymied by varying levels of conflict-related stress, generalized anxiety, and global behavioral disturbances. The average dog is exposed to a number of intrinsic and inescapable sources of stress stemming from a loss of control over vital interests, including reproductive prerogatives, expression of species-typical activities, free movement, private-space needs, conspecific interaction and company, and other stressors naturally accruing as the result of interspecific interaction and associated prohibitions. Compulsions are often expressed in the form of drive-related behavior (see *Emotional Command Systems and Drive Theory* in Chapter 6). Both compulsive behavior and drive-related behavior are resistant to extinction. Drive activity occurs when a critical arousal threshold is reached in the presence of an appropriate object or target. Similarly, under adverse motivational conditions involving frustration or conflict, disruptive compulsive modules and routines may be launched as critical arousal and frustration levels are exceeded. In addition to drive-related intrinsic reinforcement and gratification, compulsive behavior may be maintained by negative reinforcement insofar as the resulting behavior serves to reduce aversive arousal.

Neurobiology and Compulsive Behavior Disorders

Efforts to localize the brain areas responsible for the expression of compulsive behavior have generally focused on the basal ganglia (Wise and Rapoport, 1989) (see *Neurobiology of Compulsive Behavior and Stereotypies* in Volume 1, Chapter 3). The basal ganglia, also referred to as the striatal complex, consists of several integrated structures, including the caudate nucleus, globus pallidus, nucleus accumbens, ventral tegmental area, and the substantia nigra (Panksepp, 1998). According to the basal ganglia hypothesis, species-typical behaviors stored within the striatal complex as innate motor programs are inappropriately activated under the influence of stressful conflict or frustration. CBDs may ensue when the gating function controlling sensory inputs

impinging on the basal ganglia is disrupted. Among humans exhibiting OCDs, positron-emission tomography indicates that the caudate nucleus of patients exhibiting OCDs is more active than in controls not diagnosed with the disorder (Baxter et al., 1987). Under the influence of biological stress, a cascade of neurobiological changes occurs, including the release of adrenocorticotropic hormone (ACTH) and ß-endorphins by the pituitary. ACTH is a potent elicitor of self-grooming activity in rats when it is injected intracranially. ACTH-elicited grooming behavior can be decreased by opioid antagonists (e.g., naloxone or naltrexone) or increased by administering low doses of morphine (Swedo, 1989). Increased opioid release in response to stress has been demonstrated to sensitize dopamine (DA) receptors to apomorphine-induced stereotypies in mice (Cabib et al., 1984)—an agonist effect that is reversed by the administration of naloxone. Opioid receptors are distributed in close association with dopaminergic and serotonergic circuits believed to mediate the expression of compulsive stereotypies. The interaction between these neurochemical systems remains to be fully elucidated, but it is likely that opioids exert a facilitatory influence over DA activity, at least in some substructures of the striatal complex (e.g., the ventral tegmental area), whereas serotonin (5-hydroxytryptamine or 5-HT) appears to perform an inhibitory function. According to this hypothesis, in combination, opioids and 5-HT serve to functionally modulate striatal DA activity; however, things are far more complicated than the foregoing simple relation would suggest. For example, the interaction between opioid and DA systems in the basal ganglia is complementary, with endorphins producing both excitatory and inhibitory effects, depending on the substructure involved (Panksepp, 1998). Nonetheless, chronic exposure to opiates and ß-endorphins has been shown to sensitize the dopaminergic system, as evidenced by increased stereotypic activity in response to DA agonists following treatment with opiates (Cabib et al., 1984). Interestingly, the efficacy of selective serotonin (5-HT)-reuptake inhibitors (SSRIs) to control compulsive stereotypies may be, in part, due to secondary modulatory effects that they have over opioid activity. Rats exposed to chronic treatment with clomipramine exhibit significant changes in opioid function. Clomipramine has been shown to reduce central opioid levels (met-enkephalin), downregulate opioid receptor sites (mu and kappa), and reduce morphine-induced analgesia (see McDougle et al., 1999).

Opioids via their interaction with DA reward circuits in the ventral tegmental area (VTA) may mediate reward signals that serve to support repetitive stereotypies in the absence of external sources of reinforcement. Many compulsive behaviors belong to the seeking system and presumably operate under the stimulatory influence of DA, especially involving the D2 receptor subtype. DA mediates a variety of neuromodulatory functions, including a central role in making reward pleasurable. Although the relationship between increased DA activity and compulsive behavior is not without ambiguity (Goodman et al., 1992), significant evidence does suggest that DA dysregulation may play a functional role in etiology of some CBDs. Psychostimulants (amphetamines) and a variety of DA agonists injected into the ventrolateral striatum have been shown to induce oral stereotypies (biting, gnawing, and paw nibbling) in rats, an effect that is attenuated by inactivating areas of the substantia nigra (Canales et al., 2000). Amphetamines have also been shown to induce self-directed biting, head tossing, and increased vocalization in horses (Shuster and Dodman, 1998). Similar induction effects have been known to occur in domestic animals (sheep, cattle, and horses) in response to injections of the DA agonist apomorphine for many years (see Fraser, 1985). In bank voles, dose-dependent licking can be induced by apomorphine, but not jumping stereotypies (Vandebroek and Ödberg, 1997), suggesting that stress-related jumping may occur independently of the DA system or depend on a DA receptor subtype not affected apomorphine. The D_2 agonist quinpirole can induce repetitive checking behavior in rats—a behavioral compulsion that has been recently proposed as an ana-

logue of human OCD (Szechtman et al., 2001). Just as some repetitive stereotypies can be pharmacologically induced by increasing DA activity in the striatum, agents blocking or inhibiting DA activity can reduce the expression of such behavior. The differential effects of DA agonists and antagonists depend on the DA receptor subtypes that they specifically target. For example, whereas the D_2 antagonist haloperidol exerts an inhibitory effect over repetitive jumping stereotypies in bank voles (Kennes et al., 1988), clozapine, a D_4 antagonist, does not reduce captivity-induced vole stereotypies (Schoenecker and Heller, 2001). Treatment with haloperidol may result in DA receptor hypersensitivity when the DA antagonist is removed, an enhanced sensitivity that is expressed by increased stereotypic activity in response to DA agonists (e.g., apomorphine)—a modulatory effect that may be mediated by DA presynaptic autoreceptors (Martres et al., 1977).

Stress-induced dysregulation of the 5-HT system is regarded by many authorities as playing a prominent role in the etiology of CBDs. The stress-related activation of the HPA system is initiated by corticotropin-releasing factor (CRF). In addition to precipitating a cascade of peripheral hormonal changes, CRF exerts a pronounced influence on a variety of brain areas, including the inhibition of 5-HT-producing cells localized in the dorsal raphe bodies (Kirby et al., 2000). Price and colleagues (1998) found that intracranial injections of CRF produced a biphasic (inhibitory-excitatory) effect on 5-HT release. Although relatively high doses of CRF appear to increase 5-HT release, the predominant effect of CRF on the dorsal raphe bodies appears to be inhibitory, resulting in decreased 5-HT release in the striatum. In addition, Price and coworkers found that high doses of CRF produced compulsion-like behavioral changes, including intense grooming, burying, and head-shaking activities, behavioral effects that may be mediated via CRF fibers innervating the substantia nigra—the source of DA entering the striatal complex. Acute and chronic stress-related release of CRF appears to exert a significant dysregulatory effect over serotonergic and dopaminergic systems, changes that may render dogs vulnerable to compulsive disorders and other problems associated with impulse-control deficits.

Chronic overproduction of adrenal glucocorticoids may also have a pronounced effect on serotonergic activity. Smythe and colleagues (1994) have reported that brief maternal separation of infant rats (15 minutes per day) during the first 2 weeks of life has a pronounced effect on 5-HT turnover in the frontal cortex and hippocampus, an effect that appears to shadow the proliferation and distribution of stress-related postnatal glucocorticoid-receptor sites localized in these brain areas. Interestingly, however, 5-HT levels in the frontal cortex of separation-stressed animals are significantly lower in adulthood than nonstressed counterparts. The authors speculate that postnatal handling, and the temporary increase in 5-HT activity produced by it, may trigger the proliferation of glucocorticoid receptors while at the same time reducing the number of 5-HT terminals in the frontal cortex and hippocampus of adult animals, perhaps by means of a 5-HT autoinhibitory signal that impedes the ontogenetic elaboration of the serotonergic system. These findings emphasize the close involvement of the serotonergic system in the modulation of stress, as well as provide a possible explanation for the efficacy of SSRIs in the treatment of stress-related disorders. SSRIs, such as fluoxetine and paroxetine, may assist affected areas of the brain to compensate for the decreased proliferation of cortical and limbic 5-HT terminals by conserving synaptic 5-HT, thereby increasing 5-HT activity and improving the overall capacity of the serotonergic system to cope with heightened stress activity resulting from increased glucocorticoid-receptor expression. Developmental and adult exposure to stress may further exacerbate the situation. In rats, chronic corticosterone administration results in the proliferation of neocortical 5-HT_{2A} receptors and an increase of a behavior anomaly specifically associated with increased 5-HT_{2A} activity known as "wet-dog shakes" (Gorzalka et al., 1998). Interestingly, melatonin has been shown to attenuate the wet-dog shakes associated with chronic cor-

ticosterone treatment, suggesting that melatonin may have some potency as a 5-HT_{2A} antagonist and potential use in some compulsive disorders associated with chronic stress.

Attention, Dopamine, and Reward

The dog's ability to orient, select, and continuously attend to changes in the environment is a critical aspect of behavioral adaptation (see *Attention and Learning* in Volume 1, Chapter 7). The orienting response is diminished or augmented by the influences of habituation and sensitization, respectively, underscoring its reflexive nature, whereas attending behavior involving the discrimination or continuous sensory tracking of events appears to be strongly influenced by instrumental contingencies of reinforcement (Catania, 1998). Both classical and instrumental attention-related activities interface along a respondent-operant axis transforming the environment into a predictable and controllable field of activity—or not (see *Defining Insolvable Conflict* in Volume 1, Chapter 9). Environmentally produced disturbances of attention have been hypothesized as playing a central role in neurotogenesis (see *Locus of Neurotogenesis* in Volume 1, Chapter 9). As a result of exposure to environments lacking predictability and controllability, attention abilities may be strained, with behavioral output becoming progressively disorganized and ineffective. As the result of chronic exposure to adverse environments, dogs may, on the one hand, become progressively vulnerable to the elaboration of compulsive rituals or, on the other, fall victim to cognitive and output deficiencies associated with learned helplessness. Under the conditioning influence of unpredictable and uncontrollable events (insolvable conflict), affected dogs may gradually acquire a negative cognitive set, whereby they come to act as though significant consequences occur independently of what they do or believe. Such dogs may simply give up and stop trying altogether. According to this general hypothesis, some compulsive rituals and impulsive behaviors may stem from an impairment of central mechanisms controlling behavior via consequences (e.g., reward and punishment) produced by it, with the net result that repetitive stereotypies and rituals displace organized and goal-oriented behavior. This is consistent with the relative resistance of compulsive behaviors to modification by the arrangement of consequences. These observations underscore the importance of providing affected dogs with training based on highly predictable and controllable outcomes, aimed at restoring a positive cognitive set and convincing such dogs that what they do makes a difference in what happens to them. In general, a history of orderly training and reinforcement results in optimism, competence, confidence, and elated mood, whereas a history of excessive and unpredictable punishment results in pessimism, increased incompetence and insecurity, depressed mood, helplessness, and increased vulnerability to behavioral disturbance.

Dopaminergic activity appears to enhance attention, positive motivation, and learning. Mills and Ledger (2001) found that dogs treated with selegiline, a DA agonist, focus significantly better on tasks and are less distracted than controls not treated with the drug. They attribute the beneficial effect of the drug to the enhancement of positive incentive. Sensory inputs that attain selective prominence and attention do so through a variety of interacting pathways. Attractive orienting stimuli (conditioned and unconditioned appetitive stimuli) appear to converge on midbrain DA neurons located in VTA (see *Catecholamines: Dopamine and Norepinephrine* in Volume 1, Chapter 3). When animals are presented with appetitive stimuli (food), DA neurons normally respond with brief, phasic activations (Schultz et al., 1997). These DA neurons are also activated by the presentation of novel stimuli eliciting an orienting response, but this pattern of activation quickly habituates unless the stimulus is followed by the presentation of food. After repeated pairings of an auditory or visual stimulus (i.e., a conditioned stimulus or CS) with food (i.e., an unconditioned stimulus or US), the onset of increased DA neuron activity occurs immediately after the presentation of the CS, with no additional DA activity being evident when the food is actually presented (see *Classical Conditioning, Prediction, and Reward* in Chapter 1). These findings

suggest that the primary locus of positive reinforcement occurs with the presentation of the conditioned reinforcer—not the ingestion of food, which appears to be of secondary importance, at least with respect to the activation of DA reward circuits. These findings help to explain the power of conditioned reinforcement to shape behavior and the potent incentive value of bridging signals (e.g., "Good", squeak, or click). The study also provides some clues regarding the neurobiology of extinction. After a predictive association is established between the CS and US, the omission of the customary US results in a significant depression of baseline DA activity, appearing precisely at the time (relative to the CS) when rewards were presented in the past (Schultz et al., 1997).

Compulsive excesses often consist of repetitive preparatory behaviors, liberated and functioning in relative independence from consummatory goals. In such cases, the preparatory action may possess more intrinsic reward value for the dog than the actual consummatory action or object itself (see *Instinctive Drift and Appetitive Learning* in Volume 1, Chapter 5; and *Contrafreeloading*, Volume 1, Chapter 5). Dogs may be disposed to develop compulsive excesses in situations where preparatory sequences are repetitively expressed without resulting in the procurement of the attractive object, underscoring the significance of conflict and frustration in the etiology of compulsive disorders. In the case of conflict, preparatory behaviors are repeatedly expressed but unable to achieve the consummatory objective as the result of building anxiety or fear. Under the influence of frustration, preparatory behaviors are repeatedly practiced but not gratified by access to the attractive object or activity. Finally, some repetitive rituals and stereotypies may be acquired as negatively reinforced behaviors, mediating the escape and subsequent avoidance of an *internal* aversive state by responding to antecedent signals originating in the body or environment. In other words, some compulsive behaviors—apotropaic rituals—may serve to ward off, delay, or attenuate an aversive psychophysiological state originating in the body—an action that may also produce significant secondary gratification associated with increased DA and endogenous opioid activity. Such rituals may evoke parasympathetic effects aimed at modifying aversive physiological states associated with stress. Tongue playing, for example, causes a significant decrease in heart rate in Japanese black calves (Seo et al., 1998). Similarly, rhythmic leg swinging produces a reduction in heart rate among children (Soussignan and Koch, 1985). Canine apotropaic rituals correspond roughly to human obsessive-compulsive rituals, but without reference to the cognitive attributes (e.g., intrusive thoughts and irrational worries).

Dopamine imbalances have been implicated in the etiology of impulse-control deficiencies in people, in association with what Blum and colleagues (1997) have called the reward-deficiency syndrome (RDS), a condition in which an organism is unable to obtain satisfying reward gratification from everyday activities. RDS presents with increased excitability and stimulus-seeking activities, hyperactivity, and compulsivity—all behavioral changes calculated to obtain increased reward gratification. Genetic studies in people and dogs show that alterations in the expression of DA receptors have a pronounced effect on temperament and behavioral thresholds. The seeking-rage axis appears to be strongly influenced by the D_4 receptor, with the short allele being associated with reduced novelty seeking, slowness to anger, and calmness (characteristic of the phlegmatic type), whereas the long allele is associated with increased stimulus-seeking behavior (novelty), compulsiveness, excitability, and lowered thresholds for anger and aggression (characteristic of the choleric type). Niimi and coworkers (1999) have found that golden retrievers and shibas predictably differ in terms of their expression of short versus long D_4 alleles, with golden retrievers being more likely to exhibit the short allele and shibas expressing the long D_4 allele more often (see *Neural and Physiological Substrates* in Volume 2, Chapter 5).

In line with the foregoing observations, training activities incorporating highly predictable and controllable events may help to enhance a dog's general behavioral effectiveness. The use of diverting stimuli and distinct

conditioned reinforcers signaling the conclusion of a simple sequence of discrete behaviors leading to positive reinforcement appears to be useful in the management of compulsive behaviors. The activation of DA activity through conditioned reinforcement of behavior incompatible with conflict and stressful arousal may exert a significant neuromodulatory effect. Once the dog is well conditioned with food, the sound of a brief tone or click produces a pronounced orienting effect while serving to activate incompatible appetitive-incentive and appetitive-seeking activities that serve to maintain continuous tracking and attending behavior. Longer-lasting olfactory stimuli, tones, or audio recordings (music) may be paired with the presentation of meals and periods of massage. Presenting novel stimuli alone also exerts a significant disruptive or diverting effect over compulsive activity, but the use of conditioned appetitive stimuli may offer significantly more powerful effects with the added advantage of providing a means for shaping behavior incompatible with the compulsive ritual. Although conditioned appetitive stimuli ("Good", smooch, click, and so forth) may produce a stronger activating effect on DA neurons than merely giving the dog food, if such conditioned stimuli are repeatedly presented without a tangible reward, the enhanced effect is rapidly extinguished. Further, as the bridge signal becomes progressively predictive of the attractive outcome, its ability to activate dopamine neurons is reduced. Dopamine reward activation depends on prediction error, such that the attractive outcome turns out to be better than expected, whereas punishment (depression of dopamine activity) results when the outcome is worse than expected. The detection of prediction error depends on a reference or standard for comparison. To optimize the benefits of reward training, the first step is to establish a control-expectancy standard based on the arrangement of highly predictable and controllable antecedent and consequent training events. In the context of such a backdrop, outcome variations can be used to produce significant changes in the activation and depression of dopamine reward-producing circuits, changes that are of considerable usefulness in the context of canine behavior therapy (see *Prediction and Control Expectancies* in Chapter 1)

Dopamine: Behavioral and Emotional Regulatory Functions

Growing evidence suggests that stress-related modifications and imbalances of dopaminergic activity profoundly influence cognitive and emotional competence in such diverse areas as selective attention and gating functions, information processing (comparator functions, expectancies, and establishing operations), impulse control, and regulation of emotional behavior (Pani et al., 2000), and compulsive behavior. These various functions are vital aspects of adaptive learning and adjustment. Under adaptive conditions, a network of coordinated interactions between phylogenetically ancient neural substrates and more recent elaborations are integrated to achieve a harmonic organization conducive to adaptive success. Under adverse conditions of escalating stress and disorganization, this harmonic organization may become unstable or break down, thereby liberating primitive defense reactions and abnormal behaviors, ranging from compulsive excesses to impulsive aggression. DA imbalances at the level of prefrontal cortex may significantly impair a dog's ability to cope with stressful situations and to exercise effective executive control over subcortical impulses. Instead of responding in a functional and adaptive way, stress-perturbed prefrontal influences may result in a persistent failure of the dog to respond normally to frustration- and anxiety-producing stimuli, leading to over- (compulsive) or under- (hyperactive) impulse-control impairments (compulsive-impulsive spectrum). DA dysregulation of prefrontal glutamatergic circuits projecting to the striatal complex has been proposed as playing a differentiating role in the etiology of hyperactivity and obsessive-compulsive disorders (Carlsson, 2001) (see *Hyperactivity and Neurobiology*).

PHARMACOLOGICAL CONTROL OF COMPULSIVE BEHAVIOR

A prominent theory suggests that CBDs are primarily the result of disturbances affecting

the 5-HT system—a position supported by the clinical efficacy of medications that enhance 5-HT function in the treatment of canine compulsive disorders. SSRIs appear to be most effective in cases where the compulsive behavior is associated with evidence of stress and adverse emotional concomitants (e.g., anxiety). For example, among bank voles exhibiting captivity-induced stereotypies (backward somersaults), citalopram, a potent and highly selective SSRI, showed no effect until acute stress was induced, whereupon a sharp increase in compulsive activity was observed. With the onset of acute stress, citalopram produced a significant modulatory effect over the frequency of motor stereotypies (Schoenecker and Heller, 2001). Animals trained to work under stressful reinforcement schedules may also exhibit a variety of behavioral excesses. Rodents working for food presented on a fixed–interval schedule (1 to 3 minutes), show a variety of behavioral excesses [e.g., polydipsia (Falk, 1971), wood gnawing (Roper and Crossland, 1982), and paw licking (Lawler and Cohen, 1992)]. Woods and colleagues (1993) have shown that schedule-induced polydipsia is significantly reduced by SSRIs (fluoxetine, clomipramine, and fluvoxamine). Adjunctive behavior has been proposed as an experimental model of compulsive behavior (see *Adjunctive Behavior and Compulsions* in Volume 2, Chapter 5).

Significant evidence suggests that SSRIs can be effectively used to manage excessive licking, especially licking that results in local lesions of the skin known as lick granuloma or acral lick dermatitis (ALD). In hopes of obtaining an animal model for investigating human OCDs, several research psychiatrists have investigated the efficacy of SSRIs in the treatment of canine excessive licking. Judith Rapoport and colleagues (1992) at the National Institute of Mental Health (Bethesda, MD) were the first to conduct sound experimental trials to evaluate the efficacy of clomipramine and fluoxetine to control the excessive licking associated with ALD. The researchers found that clomipramine, fluoxetine and, to a lesser extent, sertraline significantly reduced the frequency of compulsive licking exhibited by dogs diagnosed with ALD (N = 37), thereby confirming previous results of an exploratory study indicating that clomipramine exerted a beneficial effect in the treatment ALD (Goldberger and Rapoport, 1991). More recently, Wynchank and Berk (1998), working with a larger sample of dogs (N = 58), have reported similar benefits resulting from the use of fluoxetine therapy. A pilot study performed by Stein and colleagues (1998) has indicated that citalopram may also be effective in the control of excessive licking, with 66.7% of the dogs treated (N = 9) showing significant improvement. In addition to demonstrated efficacy for the management of ALD, clomipramine appears to reduce tail chasing in dogs (Hewson et al., 1998; Moon-Fanelli et al., 1998; Seksel and Lindeman, 2001). The beneficial effects of SSRIs for controlling canine compulsive disorders appear to be confined to amelioration rather than cure, emphasizing the importance of concurrent behavior therapy.

Although SSRIs frequently help to ameliorate the magnitude and frequency of compulsive behaviors, they are not likely to produce a complete suppression of the target compulsive activity. For example, Rapoport and colleagues (1992) found that the SSRIs studied reduced compulsive licking by less than half in comparison to baseline measures: clomipramine (43%), fluoxetine (39%), and sertraline (24%). Only two dogs (N = 37) showed a complete remission of symptoms, and both dogs were treated with fluoxetine. This pattern of partial efficacy is comparable to the therapeutic effects of SSRIs in the treatment of human OCD. In the case of refractory OCD in human patients, fluvoxamine in combination with haloperidol, a D_2 antagonist, has been proven effective for the treatment of resistant OCD symptoms presenting with comorbid tics (McDougle et al., 1994). The interaction between 5-HT reuptake inhibitors and haloperidol appears to synergistic. For example, 5-HT-enhancing drugs have been shown to potentiate the ability of haloperidol to block DA receptor activity in the rat striatum (Sugrue, 1983). McDougle and colleagues (2000) have also found that risperidone (a potent antagonist of $5\text{-}HT_{2A}$ and DA_2 receptors) in combination with fluvoxamine is effective in the treatment of refractory OCD, with or without tics. In

addition to efficacy, a major advantage of risperidone as a treatment adjunct is that it appears to produce fewer adverse side effects than observed in the case of haloperidol.

Other veterinary clinical protocols have targeted the opioid system. The suppressive effects of opioid antagonists (e.g., naloxone, naltrexone, and nalmefene) on compulsive habits have been clinically demonstrated in dogs (Brown, 1987; Dodman et al., 1988; White, 1990; Shuster and Dodman, 1998). Opioid antagonists have been found effective for reducing excessive self-directed licking (Dodman et al., 1988; White, 1990). In a clinical study involving 11 dogs with ALD, over 70% exhibited significant improvement when treated with naltrexone (White, 1990). Adverse side effects were minimal, with only one dog showing drowsiness and social withdrawal symptoms. One report, however, has noted the occurrence of significant dermatologic side effects (acute, intense, and generalized pruritus) in a dog treated with naltrexone (Schwartz, 1993). Brown (1987) found that naloxone proved efficacious in the control of tail chasing in a bull terrier, whereas phenobarbital was ineffective. Control over tail chasing was maintained by combining pentazocine (a mixed opioid agonist-antagonist) and naloxone. After 18 months of treatment, the owners reported that tail chasing rarely occurred, so long as the medication was maintained. Blackshaw and colleagues (1994) have evaluated a variety of regimens (e.g., synthetic progestins, diazepam, and naloxone) for the treatment of refractory tail chasing. An emaciated bull terrier treated with naloxone showed significant improvement while on the medication. The dog was also given a narcotic drug (meperidine), whereupon it became more agitated and lunged at its shadow. All of the dogs (N = 32) were ultimately euthanized. Dodman and colleagues (1996) have reported that several bull terriers with tail-chasing stereotypies (N = 6) and other behavior problems [e.g., unprovoked aggression (N = 1) and intense fear (N = 1)] were affected by seizures (epileptiform spiking) and varying degrees of hydrocephalus. The electroencephalograms of all of the dogs tested were abnormal. Phenobarbital showed some efficacy in four of the tail-chasing dogs and the one dog exhibiting extreme symptoms of fear. Phenobarbital treatment of tail chasing may produce an increased risk of aggression associated with episodes (Dodman et al., 1993 and 1996). At the moment, the drug treatment of choice for the control of compulsive licking or tail chasing is clomipramine or fluoxetine (Landsberg, 2001).

Note: The foregoing information is provided for educational purposes only. If considering the use of medications to control or manage a behavior problem, readers should consult with a veterinarian familiar with the use of drugs for such purposes in order to obtain diagnostic criteria, specific dosages, and medical advice concerning potential adverse side effects and interactions with other drugs.

Potential Dietary Treatments

Serotonin production and activity may be modified via dietary means and supplementation. Diets low in protein content (e.g., 16% to 18%) and high in carbohydrate levels appear to facilitate improved transport of the 5-HT precursor tryptophan through the blood-brain barrier (see *Diet and Enhancement of Serotonin Production* in Volume 1, Chapter 3). Tryptophan supplementation has been suggested as a possible treatment alternative for the management of compulsive behavior in horses (Luescher, 1998). Another potentially valuable way to improve 5-HT metabolism involves treatment with 5-hydroxytryptophan (5-HTP). Unlike tryptophan, 5-HTP freely passes through the blood-brain barrier and bypasses a critical rate-limiting step in the metabolism of 5-HT; also, it is readily available for purchase over the counter, unlike tryptophan (see *Nutrition and Aggression* in Volume 2, Chapter 6). Finally, some evidence suggests that inositol may provide a significant therapeutic effect in the treatment of human depression, panic disorder, and OCD. In a double-blind crossover trial, OCD patients (N = 13) not effectively treated with SSRIs were given inositol or placebo for a 6-week period (Mendel et al., 1996). The results indicate that inositol exerted a significant benefit, comparable to that produced by fluvoxamine and fluoxetine. Chronic treatment with inositol has also been shown to reduce behavior associated with

anxiety and depression in rats, with some evidence indicating that inositol may exert a strong attenuating effect over anxiety following acute stress (Einat and Belmaker, 2001).

DIAGNOSTIC CONSIDERATIONS

Inclusion Criteria

A variety of criteria have been suggested to assist in the formal diagnosis of compulsive disorder in dogs. A study by Hewson and Luescher (1999) was performed to validate some of these diagnostic criteria. They compared the diagnoses made by an animal behavior expert with diagnoses based on a set of formal criteria. The owners of dogs (N = 84) with possible compulsive disorders were interviewed on two separate occasions. The first interview involved the completion of a behavior-history questionnaire, with the diagnosis of compulsive disorder requiring that the dog satisfy seven formal criteria (Table 5.1). A veterinary behavior expert whose diagnosis was based on clinical experience performed the second interview. The resulting statistical analysis showed a surprising lack of diagnostic agreement between the two methods. Of 60 dogs providing sufficient information to apply the seven formal criteria, there was agreement between the formal diagnosis and the expert's opinion in only 20% of the cases. Among these 12 cases of agreement, eight agreed on the absence of compulsive disorder and four agreed on the presence of compulsive disorder. Among the 48 cases in which disagreement occurred, 12 dogs diagnosed with compulsive disorder by the expert were excluded as not having CBD by the absence of all three formal inclusion criteria believed to be highly significant (see criteria 3, 4, and 5 in Table 5.1). Other dogs diagnosed with CBD by the expert but excluded as not having CBD by formal diagnostic criteria, included 13 dogs that met criterion 3, three dogs that met criteria 3 and 4, six dogs that met criteria 3 and 5, on dog that met criterion 4, eight dogs that met criterion 5, and five dogs that met criteria 4 and 5. Among those dogs (N=4) presenting with signs matching all three formal diagnostic criteria, there was complete agreement between the inclusion criteria and the expert's opinion regarding the diagnosis of CBD. Taken together, the lack of correspondence between the expert's diagnosis and formal diagnostic inclusion criteria suggests that the process of diagnosing such behavior problems involves a great deal of contingent fuzziness and subjective judgment.

The finding of a significant independence between the two methods of diagnosis with respect to the presence of conflict and contextual generalization is surprising, given the prominence attributed to conflict and frustration in the etiology and situational generalization of compulsive disorder (Hewson and Luescher, 1996). Even so, as a diagnostic inclusion criterion, a history of precipitating conflict and frustration is problematic, not because it lacks etiological significance, but simply because the owner may not be aware of such an influence (Wynchank and Berk, 1998). Undoubtedly, behavioral conflict and stress play an important role in the etiology and maintenance of many compulsive behavior problems, but some influence other than conflict and stress is obviously at work and

TABLE 5.1. Formal criteria for diagnosing compulsive behavior disorder (Hewson et al., 1999)

1. The dog has normal findings on physical examination.
2. The dog shows compulsive behavior (e.g., tail chasing, air snapping, and excessive licking).
3. Conflict or frustration is associated with the etiology of the behavior or present in a current situation (e.g., conflict, separation anxiety, inadequate stimulation, physical restraint, or social change).
4. The number of contexts in which the compulsive behavior has increased since it was first observed.
5. The frequency of the behavior has increased since it was first noticed.
6. The behavior is not dependent on conditioning and occurs both in the owner's presence and absence.
7. The behavior is not due to seizure activity.

needs to be clarified to complete the picture. A major problem with the conflict hypothesis is that conflict and frustration are ubiquitous and commonplace but compulsive stereotypies are comparatively rare. Why do some dogs develop compulsive stereotypies while the vast majority do not?

First and foremost, there is probably a genetic predisposition involved, and perhaps a specific genetic marker may be eventually identified to help predict, diagnose, and prevent compulsive stereotypies and related adjustment problems. Of course, this is all speculative at the moment, but such a genetic marker may not be too far off in the future. One potential candidate involves genetic variants associated with the expression of dopamine receptors (see *Attention, Dopamine, and Reward*). Among humans, individuals expressing the A_1 allele for the D_2 receptor (particularly those homozygous for it) are significantly more likely to show adjustment problems in association with impulsive and compulsive behavior (Blum et al., 1997). The A_1 allele reduces the expression of the D_2 receptor up to 30% in comparison to individuals expressing the A_2 allele, perhaps significantly impeding the carrier's ability to normally experience reward and respond to reward signals. Another potential marker of interest involves the long and short alleles expressing the D_4 receptor. Among humans, the long allele is associated with novelty seeking, compulsive-impulsive behavior, excitability, and aggressiveness, whereas the short allele is associated with hesitation, reserve, and tolerance (slow to anger) (see Ebstein et al., 1996).

According to this hypothetical model, dogs prone to compulsive behavior involving a strong locomotor and aggressive component (e.g., tail chasing) would be most likely to express a dopamine-receptor profile consistent with the choleric temperament (e.g., A_1 and long alleles). On the other hand, dogs showing self-directed compulsive behavior (e.g., licking) would be most likely to express a dopamine-receptor profile consistent with the melancholic temperament (e.g., A_1 and short alleles). Finally, dogs expressing the A_2 allele in combination with the long or short alleles for the D_4 receptor would tend to differentially exhibit propensities consistent with the sanguine (e.g., A_2 and long alleles) and the phlegmatic (e.g., A_2 and short alleles) types. These four types, corresponding to Pavlov's typology (see *Experimental Neurosis* in Volume 1, Chapter 9), are hypothetically differentiated by their relative sensitivity to signals of reward and punishment (risk and loss):

Adaptive types

Sanguine (stable extravert) or s-type: Preferentially sensitive to signals of reward, much less so toward signals of successful avoidance; prone to adaptive approach.

Phlegmatic (stable introvert) or p-type: Preferentially sensitive to signals of successful avoidance, less so toward signals of reward; prone to adaptive hesitation.

Reactive types

Choleric (unstable extravert) or c-type: Preferentially sensitive to signals of loss, much less so toward signals of threat; prone to reactive frustration.

Melancholic (unstable introvert) or m-type: Preferentially sensitive to signals of threat, less so toward signals of loss; prone to reactive fear (see Figure D.1 in Appendix D).

Dogs showing a heightened sensitivity to signals of punishment, falling along the choleric-melancholic spectrum, are generally predisposed to respond to stressful conflict and frustration by reacting (e.g., attacking, repeating, persisting, or withdrawing). Conversely, dogs showing a heightened sensitivity to signals of reward, falling along the sanguine-phlegmatic spectrum, are generally predisposed to respond to stressful conflict and frustration by adapting (e.g., approaching, searching, experimenting, and waiting). According to this hypothesis, dogs fitting the choleric-melancholic profile are more prone to develop compulsive stereotypies as the result of stressful conflict educing frustration (c-type) and anxiety (m-type). The relatively fearless c-type may respond paradoxically to punishment. In such cases, rather than suppressing ongoing compulsive activity (e.g., tail chasing), punishment may increase it. C-type dogs appear to be vulnerable to vicious circle behavior, responding to signals of punishment by increasing behavioral output rather than inhibiting it (Melvin, 1971).

Excessive or inappropriate punishment or early trauma and stress may sensitize s- and p-type dogs to signals of punishment, causing them to become progressively vulnerable to develop reactive elaborations consistent with c- and m-types. Such reactive s-type dogs are often highly sensitive to both reward and punishment signals and may show extremes of intrusive playfulness and excitability, on the one hand, and inhibition and withdrawal, on the other, with little else in between. Under the influence of excessive punishment, s- and p-type dogs may become progressively unstable and reactive to signals of punishment (threat and loss), making them more vulnerable to develop compulsive stereotypies and other adjustment problems. The disruptive sensitization and polarization of behavioral approach and inhibition systems are hypothesized to result in the dysregulation of adaptive functions (see Gray, 1994), causing the dog to become inappropriately reactive to signals of reward and punishment. The alternating bipolar impulsive excitability and depressive inhibition exhibited by reactive s-type dogs is resolved by therapy efforts aimed at reintegrating behavioral approach and inhibition systems via orderly and consistent reward-based training and play. A significant function of cynopraxic training and therapy is to promote social exchanges that reliably succeed in producing reward signals in the context of reducing interactive conflict and tension. As a result of such training, maladaptive reactivity and adjustment problems are often ameliorated or resolved while at the same time improving the human-dog relationship.

Exclusion Criteria

Differential diagnosis should distinguish compulsive behavior from transient responses to conflict, learned behaviors, and behavioral sequela associated with disease. Although stereotypical activity resulting from medical conditions (e.g., partial onset seizures) is excluded, some physical injuries and traumas may set the stage for the subsequent development of compulsive behavior. Wynchank and Berk (1998) reported that although most owners could not give a reason underlying their dogs' excessive licking, 22.4% of the dogs (N = 58) began licking after a trauma or injury to the affected area. The comfort and anxiety reduction derived from repetitive licking on an injury may establish a network of conditioned associations linking the action of licking with the elicitation of feelings of comfort and safety. As a result of the intrinsic gratification produced by licking, it may be emancipated from the original function of soothing an injury to become a generalized strategy for coping with aversive emotional arousal. Emotional distress (frustration and anxiety) is essentially an aversive state involving the loss of comfort and safety. Signals of loss and suspense may function as establishing operations activating episodes of licking behavior. Licking itself may be maintained by enhanced feelings of comfort and safety, on the one hand, and an incentive to avoid signals (internal cues) portending loss and uncertainty, on the other. In short, excessive licking is an escape or brief vacation from stressful arousal. In addition to physical injuries and trauma, excessive licking may develop in association with allergies, foreign objects, arthritis, and infections (Veith, 1986) and possibly with hypothyroidism (Aronson, 1998). As the medical cause of excessive licking is discovered and treated, the licking activity may simply stop; however, in some cases, the licking may continue and become a compulsive activity.

Air-snapping behavior, an activity giving the appearance of biting at flies, has been attributed to sensory hallucinations (Voith, 1979) and vitreous floaters, that is, particulate matter suspended in a gel-like substance behind the lens of the eye (Cash and Blauch, 1979), but no clinical evidence has been reported to date establishing such a causal relationship. Another hypothesis suggests that some cases of air snapping may stem from food sensitivities or allergic reactions affecting central nervous system activity (Voith, 1979). For example, Brown (1987) reported a case (a 1-year-old, male, cavalier) in which air snapping was rapidly resolved by feeding the dog a low-protein diet consisting of fish and milk proteins. When again fed red meat, poultry, or rabbit, the air-snapping activity recurred. This report gives some support, albeit anecdotal, to the notion that food sensitivities or allergies may contribute to the development of certain stereotypies. Behavioral stereotypies

involving episodic air snapping (Voith, 1979), tail chasing (Dodman et al., 1996), and air snapping with excessive licking (Crowell-Davis et al., 1989) have been linked to focal seizure activity. Although partial onset seizure activity may be an occasional factor in the development compulsive behavior, it appears to be relatively rare. Nonetheless, such possible causes should be excluded, along with other medical problems that might adversely affect the dog's behavior and hamper therapy efforts. The exclusion of medical causes requires a veterinary examination and appropriate diagnostic testing.

EVALUATION, PROCEDURES, AND PROTOCOLS

The treatment of compulsive behavior combines a variety of behavior-modifying strategies. The selection of specific techniques depends on a number of factors, including the severity of the compulsive behavior and the owner's ability to comply with the recommendations. In all cases, it is valuable to obtain a thorough history and medical background. Since environmental deficiencies and stressors appear to play a role in the etiology of compulsive excesses, it is necessary to evaluate such influences and make recommendations based on a subjective assessment of each situation. If environmental sources of significant conflict, stress, or frustration are identified (e.g., separation-related distress, excessive crate confinement, disorderly training, or mistreatment), efforts to reduce or eliminate such influences should be considered (see *Compulsive Behavior Problems* in Volume 2, Chapter 5). In many cases, an environmental cause is not readily identifiable, suggesting the involvement of a biological mechanism or an internal cue controlling compulsive behavior in response to generalized or conditioned frustration or anxious arousal (see *Assessment and Evaluation* in Volume 2, Chapter 5).

Many compulsive dogs are highly active and usually benefit from additional vigorous exercise, especially activities involving physical exertion but requiring a high degree of attentional focus and impulse control. Ball and flying-disk play, agility exercises (weave poles and jumps), and play-oriented obedience training may also be beneficial. Situations evocative of stress-induced compulsive behavior should be avoided as much as possible, unless ongoing behavior-therapy efforts are in place. Although many compulsive behaviors respond to behavior therapy, some pathological compulsions may persist despite the most conscientious training efforts, suggesting the presence of neurobiological disorder and the need for adjunctive pharmacological intervention. Finally, some compulsive behaviors may be a nuisance or aesthetically displeasing but not harmful to the dog. For example, sucking, kneading, and licking compulsions directed toward inanimate objects (e.g., blankets or flooring) are often best left alone unless the compulsive behavior results in damage or harm to the dog.

In addition to general contextual and motivational factors, information concerning specific triggers, the frequency of the behavior, and its duration, and time and place should be noted. Information about persons present and their proximity to the dog as well as ongoing activities should be explored. Of particular importance is the ease with which the dog can be distracted from the activity and the interval between recurring bouts. Compulsive behaviors and rituals that can be easily interrupted are typically more responsive to behavior-therapy efforts. Stereotypic repetitive behaviors that cannot be safely interrupted or that require physical restraint to stop may benefit from pharmacological intervention in conjunction with intensive behavior therapy and training efforts. By combining behavior and drug therapy approaches, there is a better likelihood of achieving more durable changes when the medication is discontinued.

Together with the objective of resolving specific complaints, counseling and therapy activities should be performed with cynopraxic goals in mind (see *Cynopraxis: Training and the Human-Dog Relationship* in Volume 1, Chapter 10). From the cynopraxic perspective, the behavioral complaint is an opportunity for owners to enhance their relationship with the dog and to improve the dog's quality of life. Ostensibly, the behavior problem brings the trainer and dog owner together for the purpose of modifying the dog's behavior, but the true intent and measure of success for cynopraxic counseling and therapy efforts is

the furtherance of cynopraxic bonding and quality of life objectives. As the result of such emphasis, even in cases where training efforts are not entirely successful in the short-term, a significant benefit is nonetheless achieved by fostering a better understanding of the problem and helping the owner to better cope with it. In addition to increasing the owner's appreciation of the dog's needs, the training and management skills acquired by the owner lay the groundwork for the long-term improvement or successful resolution of the problem as well as facilitating a more fulfilling and rewarding experience of the dog as a companion and family member.

Diversion and Disruption

Some compulsive behaviors can be effectively managed with the use of diverters and disrupters aimed at interrupting the compulsive sequence (see *Diverters and Disrupters* in Volume 1, Chapter 7). For example, tossing a ball just as the dog begins to chase its tail can be a useful diversion. Subsequent access to the toy can be made contingent upon the absence of the tail-chasing behavior. In addition to the presentation of play objects, target-arc training can be used to generate an effective diverter stimulus (squeaker, smooch, or whistle) having considerable value in the context of treating CBDs (see *Attention and Play Therapy* in Chapter 8). Savory treats can also be used to divert the dog from the compulsive ritual and to subsequently reward attending behavior or to reinforce actions incompatible with the compulsive habit. Since the dog is not performing the ritual with the purpose of controlling access to food, the provision of food as a diversionary stimulus is not likely to strengthen the undesirable compulsive behavior. Instead the diversionary presentation of food functions as an establishing operation that is more likely to set the occasion for the dog to show behavior incompatible with the compulsive action, that is, actions that enabled the dog to successfully control food-sharing exchanges with the owner in the past (e.g., attentive (begging and simple obedience modules). Disrupter-type stimuli can also be useful, especially in cases where diverters are not effective alone or in cases where the dog resumes the compulsive excess after being diverted from it. A rolled sock or one containing a small amount of popcorn and knotted is very effective in the case of mild compulsive behaviors. The sound of throw rings thrown near the dog can rapidly acquire a conditioned inhibitory effect, subsequently making them effective when tossed up and down in the hand. Similarly, a shaker can, push-button alarm, or compressed-air device can be effectively used for such purposes.

Response Prevention, Interruption, and Shaping Incompatible Responses

When excessive repetitive behavior is associated with a specific environmental event or situation, the first step, whenever possible, is to modify the environment in order to eliminate such adverse influences. In cases where environmental modification is not possible, the dog's response to the stimulation must be modified. Compulsive rituals unresponsive to interruption efforts may benefit from response-prevention techniques. During response prevention, the compulsive behavior is blocked by various means, including physical restraint. Exposure with response prevention has been proven to be effective in the treatment of a variety of human OCDs. Chasing shadows and flecks of light are common behavioral excesses among highly excitable and reactive dogs. The origin of such compulsions can often be traced to teasing games involving flashlights or laser pointers. Such behavior can be highly disruptive and disturbing, especially if it is associated with barking or destructive behavior. Since specific classes of stimuli consistently evoke such behavior, they are typically highly responsive to exposure with response prevention, counterconditioning, differential reinforcement of incompatible behavior (DRI), inhibitory training using disrupter stimuli (e.g., a modified carbon-dioxide pump or shaker can), and time-out (TO) procedures. In extreme cases, however, such behavior can be highly persistent and resistant to behavior-control strategies. For example, in one case, an English bulldog developed a highly stereotypic and compulsive aggression ritual in response to lights being turned on. The dog jumped, barked, and snapped at ceiling lights until they were turned off or until becoming physi-

cally exhausted. The ritual was extremely energetic, persistent, and aggressive. Any efforts to restrain the dog during such episodes resulted in redirected aggression, making treatment efforts dangerous and unproductive. The dog had undergone veterinary testing and treatment, including various antiseizure medications, to no avail.

Leash prompts and directives leading to the reinforcement of alternative behaviors can be helpful as a means to interrupt and diminish compulsive excesses that habitually occur in the owner's presence. For example, a dog that engages in excessive licking can be kept on a leash and collar or halter at times when it is likely to lick. When licking occurs, the action is interrupted by saying "Stop" and directing the dog's mouth away from the licked area by pulling on the leash. The licking dog can also be trained to perform an incompatible response via DRI training, such as turning its head away from the licked area on signal, perhaps redirecting the dog's interest toward a toy. A clicker can be used to bridge the occurrence of the incompatible response with a food reward or toy. In cases where the compulsive behavior occurs at a high rate, differential reinforcement of other behavior (DRO) can be introduced (see *Differential Reinforcement of Other Behavior* in Volume 1, Chapter 7). The DRO procedure provides contingent reinforcement based on the absence of behavior during some fixed or variable length of time. The primary criterion for reinforcement to occur is that the dog refrain from the compulsive activity during the preset DRO time period. An advantage of the DRO technique is that it provides a high frequency of reward and support for a variety of alternative behaviors occurring in the absence of the compulsion, more specifically those behaviors whose occurrence happens to coincide with the offset of the DRO period. Eventually, as the rate of compulsive activity is reduced, a response incompatible with licking can be brought under the control of a DRI schedule.

Bringing the Compulsive Habit Under Stimulus Control

A common complaint involving compulsive attention seeking is excessive pawing directed at family members or guests—a social excess that is prevalent among golden retrievers. Social pawing, which can be a persistent habit that resists corrective efforts, is most commonly exhibited in situations in which a dog is conflicted by opposing motivations between attention-seeking needs and unstable boundaries established to control excesses associated with it. Pawing has a controlling and obnoxious quality about it that becomes especially evident and transparent if the owner or guest attempts to stop or restrain the dog while it is performing the attention-seeking excess. Direct punishment is not recommended because of the social nature of the behavior, and many owners are justly reluctant to punish such behavior. Extinction (ignoring the behavior) is of little value for controlling such excesses.

An effective approach for resolving this problem involves bringing the pawing behavior under stimulus control. The first step is to reinforce every pawing action with the presentation of food. As the dog learns that its pawing action turns on the presentation of a treat, a vocal signal like "Paw" or "Shake" can be overlapped with the action or just slightly in anticipation of it. Once the behavior is actively under the control of the vocal signal, pawing actions that occur off cue are ignored, blocked, or suppressed by TO (the owner gets up and walks away). Pawing action occurring off cue is followed by "Stop." If necessary, progress can be facilitated by employing a response-prevention procedure, whereby a leash is used to shift the dog's weight toward the side left unsupported during pawing actions. Another method is to grasp the dog's paw and hold it firmly but without producing discomfort. At the moment when the struggle to break the control reaches a peak, the paw is released as the owner shouts "Stop." This procedure is repeated every time the dog extends his paw. Grasping the dog's paw is mildly aversive, while the act of successfully withdrawing it is negatively reinforced. By shouting the word signal "Stop" at the moment of release, the signal is associated with the subsequent paw-withdrawal behavior. As the signal becomes conditioned, it can be used to interrupt future pawing efforts. Despite conscientious training efforts, it is sometimes necessary to interrupt the behavior with an appropriate disrupter stimulus (e.g., low-pressure compressed air) or the presentation of a

scent previously paired with a compressed-air startle.

Once a dog hesitates and inhibits pawing, the owner should challenge-dare the dog by slapping a knee and delivering the words "Do you want!" in a forbidding tone of voice. The challenge-dare provokes a conflictive choice point, whereby the dog is tempted to paw but hesitates and chooses not to paw in deference to the owner's forbidding tone. If the dog resists the challenge-dare temptation, the appropriate hesitation and choice is rewarded with affection and an opportunity to give its paw on command, "Paw." The pawing response is subsequently stopped with the command "Stop" and the dog's compliance rewarded with food and petting. If the dog fails to stop or attempts to paw off-cue it is diverted, reprimanded, restrained, or timed out, as appropriate.

Excessive Licking and Tail Chasing

Excessive Licking

A dog's excessive licking directed toward its body or inanimate objects (e.g., floor, carpeting, or furniture) is a relatively common compulsive habit. Since licking is often secondary to a variety of medical causes, it is crucial that a veterinary differential diagnosis be performed to exclude such factors and provide necessary treatment. Licking excesses that result in hair loss and sores (e.g., ALD) to the extremities are best approached by the application of a combination of behavioral techniques, selected on the basis of a dog's needs and response to therapy. Modifying social and environmental sources of stress and conflict can be helpful but rarely completely resolve the problem. If licking activity is found to occur in association with an identifiable stimulus, a process of graduated exposure in conjunction with counterconditioning or exposure with response prevention might be helpful. Distracting the dog or prompting and reinforcing alternative activities incompatible with the compulsive activity may also be beneficial (e.g., fetching a toy). Excessive licking toward the body or inanimate objects often occurs when the dog appears relaxed and when little else is going on in the household (Hewson et al., 1998)—a finding that seems to suggest that such dogs lick to obtain stimulation or to comfort themselves. In such cases, supplemental massage, play, and exercise may be particularly beneficial.

A scented squeaker can sometimes be effectively used to control excessive licking. The compound squeak-and-odor stimulus is delivered at the earliest moment in the licking sequence, causing the dog to turn away from the licked area and direct its attention toward the trainer. In mild cases, the squeaker-odor combination alone may be sufficient to interrupt licking, especially in cases where the odor has been previously associated with play and posture-facilitated relaxation training. In cases requiring more control, a previously conditioned click is used to strengthen behavior that turns the dog's attention away from the licking site. Initially, the dog's orienting response to the squeaker is immediately bridged with a click and food reward. As the training process proceeds, a variable DRO schedule of reinforcement is introduced requiring that the dog not orient back toward the site of licking for some varied period followed by the click and food reward. The size and type of the food reward should be varied to maximize its reinforcement effect. Although any response other than licking is reinforced at the conclusion of the DRO period, gradually the licking behavior can be channeled into some other activity (e.g., licking peanut butter from a hollow rubber toy). Also, DRO scheduling can be followed by a series of attention and basic training exercises reinforced with food, petting, and play. The DRO schedule generates a reward-dense training situation that is highly compatible with a variety of TO procedures. For example, if a dog licks before the end of the DRO period, the schedule can be reset following a brief TO, during which licking is prevented or blocked and rewards are withdrawn for 30 seconds or so.

Many compulsive licking habits do not occur reliably under the elicitation of specific social or environmental stimuli that can be controlled or changed. For example, excessive licking activity sometimes develops in association with separation distress or boredom (i.e., frustration of the seeking system). Also, some compulsive licking may be performed as an

apotropaic ritual and maintained by the anxiety-reducing effects produced by the activity. So long as the dog is able to perform the repetitive action, it will not likely adopt other ways to cope with stress. Consequently, it is often necessary to block or prevent the licking behavior by physical restraint. In mild cases, covering the area with an elastic bandage can be a useful way to prevent licking when the owner is absent. Alternatively, in more severe cases, the dog may need to be fitted with an Elizabethan collar to prevent licking activity. When the owner is present, a leash and collar, halter, bandaging, or muzzle can be used to prevent the dog from licking or performing similar compulsive behaviors. The dog should never be left alone while wearing a leash, halter, or muzzle. Muzzle restraint can be applied contingently in response to licking episodes. If the dog licks and fails to respond to the interruption signal "Stop," the muzzle is placed on the dog. After a brief period of response prevention, the muzzle is removed, and the dog is given an appetizing chew toy (e.g., a rubber toy slathered inside with peanut butter) used to redirect licking activity. In this case, licking turns on muzzling while not licking turns it off—a contingency that may gradually help to reduce compulsive licking. At such times, massage and the presentation of an olfactory stimulus (e.g., orange, chamomile, or lavender) previously associated with safety and relaxation can be used to support arousal incompatible with anxiety. Diffusing an olfactory safety signal (OSS) into the room may also yield some benefit (see *Olfactory Conditioning* in Chapter 6).

In the case of refractory or self-mutilative compulsions, the trainer might consider various aversive counterconditioning and aversion-relief procedures. In general, aversive procedures should be applied only after less intrusive and nonaversive methods have failed. In some cases, a repellent may be applied to the licked area or to bandages, but such approaches do not appear to be very effective. Another approach that may be more effective involves the use of a taste-aversion procedure (Gustavson, 1996). Many studies have demonstrated the efficacy of taste aversion for inducing a lasting repulsion toward tastes and foods associated with nausea (see *Taste Aversion* in Volume 1, Chapter 6). In this case, a novel tasting substance is applied to the licked area. After licking the treated area, the dog is exposed to a nausea-producing agent. It is reasonable to suppose that taste-aversion therapy might produce a lasting repulsion toward the substance, perhaps sufficient to deter the dog from licking on areas treated with it. To my knowledge, this procedure has not been tested for efficacy, but it would seem to represent a possible means for controlling severe and refractory self-mutilative behavior. It should be noted, however, that the viability of taste aversion for controlling canine appetitive behavior has not proven to be very effective or durable, and the procedure is not free of potential undesirable side effects (see *Tolerance for Nausea and Taste Aversion* in Volume 2, Chapter 9).

Although various remote startle devices (e.g., shaker can, compressed air, and alarm devices) can momentarily interrupt licking episodes, the behavior tends to recover rapidly. Compressed air delivered through a modified carbon-dioxide (CO_2)-charged air pump (see *Modified Carbon-dioxide Pump* in Chapter 2) can be scented with an odor (e.g., citronella-eucalyptus mix). After the dog is sensitized to the odor, it can be applied to the licked area to produce a more lasting effect. A brief burst of scented air is directed toward the area being lick, both startling the dog and leaving a scented reminder on the spot. The diluted scent can be subsequently applied to the area with a cotton squab. Odors previously associated with startle may directly inhibit licking or potentiate the effect of other (weaker) startling events, thereby making them more effective. A remote-activated citronella collar can be used to produce a similar result. Again, a dilute citronella scent can be applied directly to the area, taking care not get the material into open sores. Finally, a scented seven-penny shaker can is sometimes used in a similar way to disrupt excessive licking. When the can is first used, it should be tossed near the dog to produce a sensitized response to the sound and odor. After a few such exposures, a shake or rattle of the can will evoke a strong inhibitory response. Such techniques should only be used in the context of reward-based training efforts in which alternative behavior is prompted and rein-

forced after licking is inhibited (e.g., giving the dog a hollow rubber toy smeared with peanut butter).

An aversive technique that has shown efficacy for inhibiting excessive licking is remote-electrical training. Eckstein and Hart (1996) were able to suppress compulsive licking in four dogs (N = 5) after delivering an average of 12 brief shocks per dog. The suppressive effects of electrical stimulation were rapid and highly durable (see *ES and Refractory Compulsive Behavior* in Chapter 9).

Tail Chasing and Whirling

Since tail chasing often occurs in situations involving increased excitement and frustration, it may be useful to anticipate such behavior by using a response-prevention procedure or by increasing obedience control at such times. Also, some dogs may benefit from compensatory stimulation (e.g., ball play) or the presentation of various anticipatory diverters or disrupters. An orienting response to a squeaker-odor stimulus is used to interrupt whirling momentarily in anticipation of initiating a DRO procedure. A well-conditioned click and food reward can be used to support the orienting response, with subsequent clicks and food rewards following after varying brief periods of abstinence from whirling activity in accordance with DRO schedule requirements. The DRO schedule provides reinforcement after a fixed or variable interval, provided that the dog does not chase its tail. If the dog does whirl, the vocal cue "Stop" is presented and the compulsive action is interrupted, whereupon the dog is restrained to a tie-out or TO area. When interrupting tail-chasing behavior, great care and caution should be taken, since some dogs may respond aggressively when interfered with at such times. In cases where a risk of attack exists, added precautions should be taken, e.g., muzzling or keeping the dog on a leash and muzzle-type halter that produces a clamping action on the dog's jaws. During TO, the dog's leash is pinched in the doorjamb, leaving it with enough room to stand and sit but not chase its tail (response prevention). The TO should not exceed 1 minute, with 30 seconds often being sufficient. At the conclusion of TO, the dog is returned to the evoking situation and the DRO schedule reinstated. In the early stages of DRO training, the compulsion-free period should be adjusted to maximize the flow of rewards and reinforcement of behavior incompatible with tail chasing. In addition to the suppressive effects produced by the loss of food and social rewards, the contingent application of a brief TO appears to help de-arouse such dogs.

Another method of some value for the control of compulsive whirling involves bringing the behavior under stimulus control. Waving a hand in a wide circular direction above a dog's head can often evoke tail chasing. In cases were this does not initially evoke the whirling response, a vocal or visual signal can be paired with spontaneous tail-chasing events. After several repetitions, the signal itself will gradually evoke the whirling response. As the dog starts turning, a conditioned reinforcer (e.g., click) is delivered and a treat is tossed to the floor in front of the dog. If the dog stops, the training procedure is repeated; if not, the behavior is interrupted with the vocal cue "Stop" followed by appropriate disruptive stimulation (e.g., toss of a shaker can or compressed air with deterrent odor) or restraint. This pattern is repeated until the dog starts and stops whirling on signal. Tail chasing is interrupted at the earliest sign or intentional movement, whereupon the whirling response is countermanded by a response incompatible with tail chasing (e.g., stay or sit). All tail chasing or whirling off cue is either blocked or suppressed. This procedure is carried out until the dog's impulse to chase its tail is replaced by an incompatible response or reduced sufficiently to employ a DRO and TO procedure, as already described.

In cases where a dog fails to stop on signal or is unresponsive to disruptive stimuli, electronic training may be useful. Whenever remote electronic devices are used, the dog should first receive appropriate safety training. Initially, the least aversive electrical (e)-stimulus sufficient to stop tail chasing is used. During the escape phase, a continuous stimulus is applied until the dog stops whirling, at which point a conditioned negative reinforcer is delivered just before the e-stimulus is turned off. The avoidance phase is

initiated by presenting the vocal signal "Stop" just before the e-stimulus is delivered. Once the dog demonstrates an ability to control the tail-chasing behavior in response to low-level e-stimulation, a stronger e-stimulus can be introduced with the goal of suppressing it. The vocal signal "Stop" is coupled with the immediate delivery of a momentary e-stimulus set at a moderately high level. To produce an effective reminder to deter future tail chasing, a novel odor (citronella) is applied beforehand to the dog's tail or rear end. Later, the deterrent odor can be administered contingently by using a CO_2 pump sprayed in the direction of the dog's tail (see above) or via a remote citronella collar.

Automated Training

Given the common incidence of canine licking and tail-chasing compulsions, future research efforts should explore the viability of automated devices designed to detect compulsive activity and to deliver appropriate consequent events. Such devices are especially needed in the case of compulsions that occur when the owner is absent. Behavior-activated devices are in widespread use for the control of boundaries and barking excesses, providing a foundation of technology for more sophisticated behavior tools for measuring and treating behavior problems. For example, in the case of excessive licking, a pressure- or moisture-sensitive device could be programmed to detect both the absence and presence of licking, thereby keeping track of the behavior objectively. Such a device could be designed to interface with a treat dispenser for the purpose of DRO training or for shaping an incompatible response (e.g., lever pressing). The device could also be programmed to deliver lick-activated aversive stimulation as well as safety odors, thereby making the process of inhibitory training more efficacious and lasting. In the case of excessive tail-chasing and whirling compulsions, a movement-sensitive device could detect whirling movements, record their duration and frequency, and provide appropriate consequent events to promote DRO training, shape incompatible behavior, deliver whirling-contingent aversive stimulation, and the release of safety odors.

PART 2: HYPERACTIVITY AND HYPERKINESIS

Behavioral complaints involving overactivity and impulsivity are common with dogs, with certain breeds (e.g., hunting and working dogs) tending to exhibit such adjustment problems more often, suggesting that a strong genetic factor may be involved. As the result of conscious and unconscious selection pressures, hunting and working breeds have undergone various biogenetic changes conducive to working functions, including increased activity levels, low-threshold attention and orienting responses, and rapid behavioral adjustments to environmental stimulation (impulsivity). From the perspective of utility, such traits may significantly enhance the performance of hunting and working dogs. Such dogs are often required to search large areas as rapidly as possible, making traits conducive to high activity and energy of tremendous value. A high degree of excitability and rapid attentional shifting and sifting through environmental stimuli would also enhance the ability of hunting dogs to search for game. The best detector dogs are highly energetic, impulsive, and driven to locate hidden objects. Guarding dogs benefit from increased attentional shifting and hypervigilance in the detection and anticipation of potential threats. Impulsive and fearless action may serve hunting dogs in the pursuit of game and provide a significant advantage to working dogs when faced with risky or threatening situations requiring immediate and uncalculated action. Impulsive behavior is particularly advantageous in situations requiring split-second decisions. However, when comorbid oppositionality (fairly common among hyperactive dogs) and impulse-control deficiencies present together with a tendency toward rapid behavioral adjustments and fearlessness, the risk of aggression may be increased. A more common characteristic of hyperactive dogs is playfulness, with such dogs appearing to obtain pleasure from drive-related modal activity that involves environ-

mental and social exploration, novelty seeking, and the search for positive prediction error, that is, a preoccupation with reward seeking.

Although high activity and excitability levels may be desirable in the case of hunting and working dogs, such traits often result in significant disruptive behavior and training problems when expressed in the home (Voith, 1980). Hyperactive dogs often exhibit intense greeting rituals involving sustained jumping up, running about, and other behavior indicating a high level of arousal (e.g., barking and mouthing on hands and clothing). Such dogs may persist in such behavior despite repeated efforts to correct or restrain them. In addition to social intrusiveness and oppositional behavior, overactive and impulsive dogs frequently exhibit numerous control-related behavior problems (e.g., jumping on counters, destructive behavior, and reckless behavior around children). Hyperactive dogs often appear to be possessed by an insatiable desire to play and explore, grabbing virtually anything that they can get into their mouths, occasionally swallowing objects that cause gastrointestinal distress or blockage that requires veterinary treatment. When walked, such dogs often become extremely active, excited, and distracted, forcefully pulling into the leash, barking, and exhibiting various other impulsive behaviors that greatly distress their frustrated owners. These impulsive excesses on leash frequently lead to exercise and stimulation deficits simply because owners give up trying to walk and exercise them. When transported by car, overactive dogs may frantically pace back and forth, pant continuously, and bark at passersby and other dogs. These various excesses and adjustment problems almost invariably result in the use of inappropriate punishment and confinement further depriving hyperactive dogs of needed stimulation and exercise. Hyperactive dogs are exposed to excessive crate confinement or banishment to the backyard, where they dig, destroy plants and shrubbery, and engage in nuisance barking.

Although the crate can be an effective management tool, when used excessively or inappropriately it can become the hub of a vicious cycle of restraint and escalating compensatory activity and other adverse side effects. The use of a plaster cast for mending a broken arm offers an apropos metaphor for appreciating the benefits and risks of crate confinement. When used properly, the cast provides a highly beneficial effect by keeping the arm in a fixed position. However, if the cast is left on the arm for too long, significant adverse side effects will gradually overshadow its benefits, with the muscles of the arm gradually atrophying and losing strength. Similarly, the constructive use of crate confinement can be highly effective and beneficial, but if it is used as a substitute for training or employed excessively or inappropriately (e.g., as a place for time-out), crating may produce a variety of undesirable side effects (see *Dangers of Excessive Crate Confinement* in Chapter 2).

Compulsivity and Hyperactivity: Evolutionary Considerations

Compulsive disorders and hyperactivity appear to be phenomenological opposites sharing a common axis of impulse-control impairment and behavioral excess but in opposite directions. Whereas compulsive dogs appear to take pleasure in repeating certain sequences of behavior to the point of excess, hyperactive dogs appear to be intolerant of repetitive routines, showing a preference for behavioral change and novelty. Dogs tending toward compulsivity appear to be more routine oriented, whereas the behavior of hyperactive dogs tends toward a high level of variability (see *Cognitive Interpretations and Speculation* in Volume 2, Chapter 5). Compulsive dogs tend toward introversion (self-directed), avoidance of danger, and the performance of repetitive routines (phlegmatic-melancholic axis), whereas hyperactive dogs are more extraverted (other-directed), outgoing, reward seeking, fearless, and variable in their behavior output (sanguine-choleric axis). The evolutionary differentiation of traits tending in the complementary directions of compulsivity and impulsivity would provide an adaptive hedge against changing environmental circumstances. Under

stable circumstances of plenty, compulsive traits associated with repetitive tasks, routines, and security seeking would be adaptive whereas, at times of crisis and starvation, increased behavioral impulsiveness, variability, fearlessness, and tolerance for disgust would provide a significant advantage. Interestingly, hyperactive dogs often engage in pica and coprophagy, suggesting the possibility that such vices and hyperactivity may be linked by a common evolutionary function—survival under adverse conditions (see *Encoded Survival Habits* in Volume 2, Chapter 9). Hyperactive traits may serve to increase survivability during times of adversity, starvation, and upheaval, whereas compulsive traits would be more conducive to settled and relatively stable circumstances. Under highly organized and stable conditions, disruptive hyperactive behavior becomes a source of social concern and the focus of behavioral control efforts in both humans and dogs.

HYPERACTIVITY AND NEUROBIOLOGY

A dog's nervous activity can be conceptualized as resulting from the dynamic interplay of excitatory and inhibitory neurotransmitters, especially gamma-aminobutyric acid (GABA) and glutamate, respectively, operating under the modulatory influence of monoamine neurotransmitters (e.g., DA, 5-HT, and NE), a host of neuropeptides (e.g., CRF, opioids, oxytocin, and arginine vasopressin), and other psychoactive substances (e.g., lipids and fatty acids). Normally, cortical inhibitory processes actively modulate excitatory subcortical neuroactivity. The result is organized and highly regulated activity. In hyperactive dogs, cortical inhibitory processes appear to be insufficient to regulate excitatory impulses. Hyperactivity, inattentiveness, and impulsivity may persist despite repeated punishment involving both aversive stimulation and the loss of reward, suggesting that the disorder may involve an impairment of executive control functions. Current research emphasizes the involvement of frontostriatal circuits—including prefrontal and orbitofrontal areas, the striatal complex, and the anterior cingulate—in the etiology of hyperkinetic impulsivity. When functioning properly, each of these areas contribute to the expression of integrated and organized behavior, providing the when-what-where mechanisms by which dogs establish control over the environment and optimizes their ability to exploit it.

Executive impulse-control abilities only gradually acquire full functional activation and capacity (Rubia et al., 2000). Young dogs frequently exhibit hyperactivity and impulse-control problems that improve with age, implicating an ontogenetic normalization of attention and impulse-control abilities. In the case of hyperkinetic dogs, impaired or reduced cortical activity may persist, stemming from an organic impairment affecting the frontostriatal system. Carlsson (2001) has suggested that obsessive-compulsive disorder (OCD) and attention-deficit hyperactivity disorder (ADHD) are conditions that stem from the dysregulation of prefrontal glutamatergic activity. According to this hypothesis, OCD and ADHD are cognitive and behavioral antipodes, with obsessions and compulsive behavior resulting from prefrontal overactivity, whereas hyperkinetic inattentiveness and impulsivity are the result of prefrontal underactivity. Treatment with psychostimulants appears to increase prefrontal activity via dopaminergic activation of glutamate circuits, thereby normalizing function. Interestingly, normoactive dogs given D-amphetamine exhibit increased stereotypic activity (Bareggi et al., 1979), a finding consistent with Carlsson's hypothesis that cortical overactivity may underlie the elaboration of compulsive rituals. Various lines of research are currently under way to isolate the neurobiological causes of ADHD, with most theories focusing on disturbances of 5-HT and DA neurotransmission. Both serotonin and dopamine serve to modulate excitatory (glutamate) and inhibitory (GABA) systems governing emotional and motor activity (see *Neural and Physiological Substrates* in Volume 2, Chapter 5). In addition to stimulating dopaminergic activity, psychostimulants

increase alertness and cortical arousal via noradrenergic circuits.

Pharmacological Control of Hyperkinesis

Generally, hyperactivity is differentiated from hyperkinesis by identifying behavioral indicators and the performance of a stimulant-response test (see *CNS-stimulant Response Test* in Volume 2, Chapter 5) (Luescher, 1993). Unlike hyperactive dogs, hyperkinetic dogs show a paradoxical response to psychostimulant therapy; that is, instead of becoming more active under the influence of stimulants, hyperkinetic dogs become less active and impulsive and more responsive to inhibitory control (see *Hyperactivity versus Hyperkinesis* in Volume 2, Chapter 5). Psychostimulant therapy appears to reduce symptoms of human ADHD in approximately 80% of diagnosed cases (Paule et al., 2000). Although hyperactivity is common in dogs, stimulant-responsive hyperkinesis appears to be much less common in dogs than in people, but good epidemiological studies are lacking in this area. Whether the disorder is actually rare or underdiagnosed remains to be determined. Criteria for identifying impulsive and overactive dogs that may be hyperkinetic (and warrant stimulant-response testing) remain to be developed and validated. Luescher (1993) has suggested that hyperkinesis often presents with multiple and serious behavior problems.

In the past, D-amphetamine was the most common drug used to control hyperkinesis, but other medications have also been effectively used to control the problem in both children and dogs. Arnold and colleagues (1973) have compared the efficacy of D-amphetamine with L-amphetamine for the control of hyperkinesis and aggression in dogs. They found that the D-isomer was approximately three to four times more effective in the control of hyperkinesis than was the L-isomer. However, both drugs proved equally effective in the control of aggression associated with hyperkinesis. The only significant difference between the two drugs was that the effect of L-amphetamine lasted only half as long that of D-amphetamine. The most common alternative drug for the control of human ADHD is methylphenidate. Although effective and perhaps producing fewer side effects (less agitation and fewer stereotypical behaviors), the drug wears off more rapidly and does so precipitously—a potentially dangerous pharmacokinetic feature in the case of aggressive dogs (Drastura, 1992). Voith (1980) reports success using the tricyclic antidepressant amitriptyline for the control of hyperactive symptoms not responsive to central nervous system (CNS) stimulants.

Another medication that may offer some additional benefits in the treatment of hyperkinetic symptoms is clonidine, which has shown promising efficacy with children diagnosed with ADHD not responsive to CNS-stimulant therapy. The drug appears to enhance impulse control and improve frustration tolerance in overactive and uninhibited children (Riddle, 1991). When clonidine is given with methyphenidate, the combination may produce beneficial synergistic effects and be particularly useful in the treatment of impulsive aggression presenting comorbidly with hyperkinesis (Connor et al., 2000)—a potential treatment regimen that remains to be evaluated for safety and efficacy in dogs. Also, when given together, a smaller dose of methylphenidate may be required to produce a therapeutic effect.

Schnackenberg (1973) has reported that caffeine works about as well as methylphenidate in children diagnosed with ADHD. Subsequent studies were not been able to confirm these observations (Garfinkel, 1975). Krushinskii (1960), who performed several experiments exploring the effects of caffeine on excitability in dogs, arrived at two general conclusions concerning the effect of caffeine on general excitability:

> It was shown, first, that excessively large doses of caffeine, causing a sharp increase in the process of excitation, produce limiting inhibition. Consequently, the conditioned reflexes are not increased; on the contrary, they are depressed … Second, it was shown that the effect of caffeine on the process of excitation is largely dependent on the typological properties of the nervous system. In animals with a weak type of nervous

> system, administration of only small doses of the drug leads to an increase of the conditioned reflexes; larger doses depress conditioned reflex activity. Just as during weakening of the nervous system by excessive nervous strain, castration, or old age only the slight increase in excitability obtained by the use of small or average doses of caffeine leads to an increase in the conditioned reflexes. The administration of large doses depressed them. (57)

Despite these intriguing observations, as things currently stand, caffeine has no "real place in pharmacotherapy" (Werry, 1994:327). Caffeine probably offers little or no benefit in the treatment of canine hyperkinesis; however, to my knowledge, the potential value of caffeine for controlling hyperkinesis in dogs has not been clinically evaluated.

Essential fatty acids (EFAs) are necessary for healthy brain development and function. Children with EFA deficiencies, especially omega-3 fatty acids, may be more prone to exhibit learning difficulties and behavior problems associated with ADHD (Stevens et al., 1996). Supplementation with EFAs has been shown to alleviate ADHD-related behaviors and improve cognitive function in children. The value of EFA supplementation in dogs exhibiting hyperactivity, inattentiveness, and impulsivity has not been clinically evaluated, but given the apparent benefits of such supplementation in human psychiatry (see *Aggression and Diet* in Chapter 7), such investigation appears to be warranted.

Note: The foregoing information is provided for educational purposes only. If considering the use of medications to control or manage a behavior problem, readers should consult with a veterinarian familiar with the use of drugs for such purposes in order to obtain diagnostic criteria, specific dosages, and medical advice concerning potential adverse side effects and interactions with other drugs.

BEHAVIOR THERAPY

Hyperactive dogs exhibit several cognitive and behavioral characteristics that may impair their ability to organize behavioral output and effectively adjust. In addition to increased activity levels, hyperactive dogs are easily distracted, impulsive, and lack the ability to rapidly stop or inhibit motivated behavior. The sheer volume of searching and impulsive activity exhibited by such dogs can be daunting and extremely frustrating for dog owners. Since hyperactive dogs show a characteristic inability to respond to conditioned inhibitory signals, an excessive reliance on interactive punishment is common, often making matters worse. A hyperactive dog's inability to stay still for long appears to be a function of emotional impulsivity (seeking-system imbalance), driving the dog to seek drive-activating stimulation or intensify gratification. As a result, performing tasks requiring a delay of gratification or response inhibition places an onerous demand on such dogs. Instead of hesitating, appraising the situation, and selecting an optimal course of action (control module), hyperactive dogs appear to respond swept up by transient impulses in search of immediate gratification. In addition to emotional impulsivity, the behavior of such dogs appears to be dominated by insatiable modal searching routines operating under exploitative incentives. Many of these dogs exhibit a low-threshold orienting response, causing them to scan the environment rapidly and without lingering for long on any one source of stimulation.

Reinforcement and Extinction Peculiarities Associated with Hyperactivity

Sagvolden and colleagues (1998) have proposed that normoactive and hyperactive animals (spontaneously hypertensive rats) and ADHD children respond differently to reinforcement and extinction procedures. ADHD children appear to be averse to reinforcement delays, preferring the accumulation of small rewards delivered immediately to the receipt of larger rewards requiring them to wait. In contrast with hyperactive counterparts, normoactive children appear to prefer schedules of reinforcement in which rewards are gradually maximized and presented as large accumulated earnings. Also, the behavior-strengthening effects of delayed and immediate reinforcement significantly differ between normoactive and hyperactive animals and

children. In normoactive animals, not only are behaviors that directly result in reinforcement strengthened, but so are other responses leading up to the reward. More formally stated, a delay of reinforcement gradient is formed as a function of the time elapsing between the emission of a response and the delivery of reinforcement, such that behaviors occurring early in the sequence are strengthened but to a lesser extent than those occurring immediately before the reinforcing event (Figure 5.1). In the case of hyperactive animals, only those behaviors occurring in close proximity with the delivery of reinforcement are affected, gradually resulting in their exaggeration and predominance over behaviors occurring earlier in the sequence. After repeated trials, reinforcement causes hyperactive animals to differentiate from normoactive counterparts in interesting ways. For example, the behavior of normoactive animals tends to be more goal oriented and organized in comparison to the hyperactive animal's impulsive and massed response bursts primarily occurring just before reinforcement is anticipated to occur. These findings suggest that the

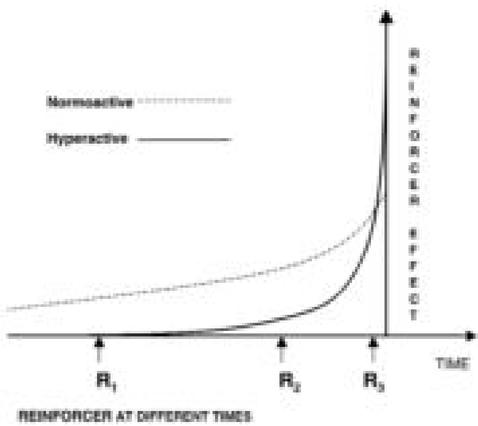

FIG. 5.1. Theoretical delay of reward gradient comparing hyperactive and normoactive animals. Hyperactive dogs appear to be affected by a number of learning impairments, including a delay of reinforcement deficiency that impedes their ability to produce goal-directed and organized output. Unlike normoactive counterparts, hyperactive dogs tend to concentrate impulsive behavioral efforts to occur immediately before the anticipated reward is delivered. After Sagvolden et al. (1998).

impulsivity associated with hyperactivity may be acquired as the result of the distinctive way hyperactive animals respond to reinforcement. In addition, hyperactive rats appear to respond differently to extinction procedures than do normoactive ones. Although hyperactive rats initially exhibit a reduction of behavior during signaled extinction trials, they rapidly resume responding and persist in doing so at high levels despite the absence of reinforcement. Hyperactive rats appear to recognize when reinforcement is no longer forthcoming, but are unable to maintain response inhibition during signaled extinction periods. Similarly hyperactive dogs exhibit intolerance for waiting and respond best to immediate reinforcement. During the training of such dogs, it is important that rewards be presented on a frequent basis rather than requiring them to wait too long or perform several responses for a deferred reward. Consistent with findings from experiments with hyperactive animals and children diagnosed with ADHD, extinction procedures (ignoring intrusive and impulsive behavior) are not usually very effective in the behavioral treatment of hyperactive dogs.

These various impairments of reinforcement and extinction processes impede a hyperactive dog's ability to adjust to changing circumstances, with the consequent breakdown of integrated behavior. Impulse control develops as the result of goal-directed behavior and inhibitory conditioning processes occurring naturally as organisms interact with the environment. Normally, dogs learn from an early age that certain behaviors are either dangerous or do not pay off, and consequently learn to stop exhibiting those actions—a process that is gradually internalized as impulse control. Dogs also learn that some behaviors alter the environment in ways that produce pleasurable or rewarding outcomes. Consequently, two general alterations occur during the process of behavioral adaptation: (1) response inhibition (impulse control) and (2) response excitation (goal-directed and integrated behavior). Adaptive behavior is motivated to avoid aversive events, on the one hand, and to optimize control over attractive ones, on the other. Practically speaking, socially acceptable behavior is acquired and

maintained by structuring the dog's activities in accordance with various contingencies of reward and punishment. Training procedures consist of attractive and aversive events presented in accordance with controlling signals (e.g., discriminative stimuli and conditioned reinforcers) in order to systematically shape behavior toward some behavioral objective. In the case of disruptive hyperactive behavior, the goal of behavior modification and training is to promote the development of a regulated and organized repertoire of cooperative behavior. Training activities serve to establish instrumental control modules and routines that are incompatible with disruptive impulsivity to enhance attention and impulse control, and to generally increase the dog's ability to effectively organize its behavioral output. A dog's ability to control impulsiveness involves at least four aspects: the ability to restrain a preferred response at the level of intention, to stop an action that has been initiated but not fully consummated, to continue an action despite environment interference, and the ability to delay a response (see Rubia et al., 1998). All of these aspects are addressed in the training of hyperactive dogs.

Reward-based Training and Play

The training of hyperactive dogs involves shaping instrumental control modules (e.g., sit, down, and stay) and improving attending and waiting behaviors. The strengthening of enhanced attention and impulse control is most practically and beneficially attained through highly structured and reward-based training efforts in combination with TO and response-blocking procedures. Such training should focus on developing a repertoire of compliant behaviors integrated into everyday activities. First establishing a set of highly consistent predictive control expectancies and then varying the type, size, frequency, and timing of attractive outcomes against this control expectancy standard helps to optimize reward-based training efforts by introducing positive prediction error (surprise) and a variety of beneficial dissonance effects. Not only does basic training induce a significant calming effect in most hyperactive dogs, it also provides owners with more constructive means for controlling impulsive and oppositional behavior. In addition to basic training and attention therapy, providing hyperactive dogs with contingent access to vigorous play activities can further enhance control efforts while providing overactive dogs with beneficial ways for obtaining high levels of quality stimulation and reward. Ball play can be structured so that the opportunity to chase the ball is made contingent on the dog waiting by standing, sitting, or lying down, thereby improving impulse control and reinforcing more cooperative behavior. Playful activities that involve jumping up, biting and tugging on toys, running about, and wrestling (in the case of friendly dogs) can be provided contingently as a reward following the performance of basic exercises. Also, repeatedly turning play on ("Okay") and off ("Enough" or "Out") appears to help overactive dogs to learn better self-control over playful social excesses and impulsive behavior.

Time-out, Response Prevention, and Overcorrection

The most common means used by dog owners to control hyperactive excesses are extinction and punishment. Efforts to extinguish hyperactive behavior by ignoring it are rarely successful, and the punitive measures often used by owners are inconsistent and ineffective, usually only serving to exacerbate the situation. Disruptive hyperactive behavior may be so pervasive and persistent that reward strategies may be thwarted, requiring complementary inhibitory training efforts aimed at restraining oppositional or intrusive excesses. The most successful programs of behavior therapy and training combine reward-based training, punitive procedures (e.g., exclusionary and nonexclusionary TO), and various response-blocking techniques. Keeping the dog on leash while in the house enhances the owner's ability to interrupt and redirect unwanted behavior, effectively apply TO procedures, and prevent many common excesses associated with hyperactivity.

In combination with TO and response blocking, overcorrection can be highly effective. The overcorrection procedure requires that the dog repeatedly perform a behavior

that is incompatible with hyperactivity [see *Negative Practice, Negative Training, and Overcorrection (Positive Practice) Techniques* in Volume 1, Chapter 8]. One overcorrection procedure requires that the dog perform a long-down stay (1 to 10 minutes) whenever it exhibits a loss of impulse control or target-intrusive excess. Initially, the dog is frequently rewarded with affection and food while staying in place, with the reward frequency gradually tapering off until it is delivered only at the end of the stay period. Massage can help encourage a dog to relax, especially if the dog needs to be manually restrained in the down position. Another overcorrection technique requires that the dog repeatedly perform a series of obedience exercises (e.g., sit, down, sit from the down, and stand). Each behavior is positively reinforced, and the full overcorrection cycle of exercises is slowly repeated 5 to 10 times in a row, as needed to restore attention and impulse control. Similarly, hyperactive dogs can be exposed to integrated compliance training, which requires dogs to sit, stay or wait, and make eye contact before engaging in various preferred everyday activities. For example, hyperactive dogs should be routinely required to sit, wait, and make eye contact before being let outdoors, before being let indoors, before receiving treats and meals, before going up or down stairs, before getting into the car, before being released to play, before being permitted on furniture, and before receiving affection and petting. The idea is to use everyday rewards as opportunities to enhance attention and impulse-control abilities.

By defining (and adjusting as necessary) a continuum of progressive compliance, owners are better able to direct behavioral change in an efficient and goal-directed way, minimizing negative interaction and reactive resistance—undesirable outcomes that are more likely to occur in cases where more difficult demands are made too hastily. The next important step in the process is to generalize learning to a broader range of situations that provide greater environmental and social stimulation of the dog. For example, once training is mastered in the home, it can be gradually transferred to other more uncontrolled situations. Enrolling the dog in an obedience class can be extremely useful at this point. To be most effective, all family members need to play an active and consistent role in the training process.

Posture-facilitated Relaxation Training

Few activities are more beneficial than posture-facilitated relaxation (PFR) training and massage for promoting calmness and composure in hyperactive dogs. The musculature of such dogs is often stiff with anticipation and readiness to act, especially in the case of dogs operating under the influence of heightened sympathetic arousal. Hyperactive dogs often reach a deep state of relaxation more rapidly than normoactive counterparts. The procedure incorporates nonthreatening prompting movements together with sustained massage toward the induction of a pronounced relaxation response. The postural prompting and restraint associated with PFR training appears to play an instrumental role in the relaxation process (see *Posture-facilitated Relaxation* in Chapter 6 and Appendix C). As the result of such handling, opponent tensing and releasing of muscles produces a progressive calming and enhanced receptivity to massage. The induction of relaxation by systematically tensing and releasing of muscle groups plays a prominent role in the treatment of human fear and anxiety disorders by systematic desensitization. Grandin (1992) has reported some relaxation benefits associated with sustained squeezing in the treatment of human autism and hyperactivity. In addition to postural restraint and manipulation, taction helps to support and promote relaxation. Gantt and colleagues (1966) and others following him have emphasized the pronounced effect that touch contact has on dogs via the parasympathetic branch of the autonomic nervous system (see *Taction and PFR* in Chapter 7). Touch lowers blood pressure, decreases heart and respiration rate, reduces stress-activated hypothalamic-pituitary-adrenocortical (HPA) axis activity, and generally appears to promote homeostatic equilibrium. The combination of 10 minutes of reward-based training and 20 minutes of vigorous play, followed by a 5-minute session of PFR training, is a positive prescription for

change in the case of many hyperactive dogs.

HYPERACTIVITY AND SOCIAL EXCESSES

Hyperactivity and intrusive behavior appear to develop in the context of unresolved competitive conflicts and tensions. These interactive sources of conflict usually revolve around situations in which the mutual control interests of dogs and owners converge upon and conflict over the access to everyday rewards. Under the influence of owner interference and ineffectual control efforts, a puppy's behavior may become progressively organized around competitive modal strategies fueled by the intermittent reinforcement of intrusive and oppositional behavior. Problematically, the relationship between the owner and dog gradually takes form around these points of conflict and tension. Instead of producing harmonious and cooperative interaction, competitive exchanges and transactions between the owner and dog generate a variety of undesirable emotional and behavioral outcomes. In the dog's case, its behavior may become progressively hyperactive, intrusive, and disruptive. The owner may interpret the dog's emergent competitive behavior as dominating and threatening social order, but, in fact, these dogs are more aptly described as dependent and incompetent subordinates in search of a leader. Furthermore, the greatest actual threat to social order in such cases is the owner's failure to assume an appropriate leadership role and help the dog learn more acceptable ways to gratify its needs. Operating under the delusion of a dominance challenge, the frustrated owner may reactively turn to ineffectual and inconsistent punitive efforts to control disruptive behavior. Punishment in such cases may only serve to further complicate interactive conflicts and tensions, amplify competitive arousal, and further differentiate the dog's incompetent efforts to gain control over everyday sources of comfort and safety (reward). Instead of finding a leader, the dog finds a punitive adversary impeding its ability to adjust and succeed. In addition to exaggerating undesirable active-submission behaviors (e.g., jumping up, barking, and begging), the chronic reliance on punishment may cause the hyperactive and intrusive dog to gradually lose its ability to truly submit and defer, but nonetheless refrain from openly competing with the owner. Instead, the dog may engage in a variety of socially flirtatious and ambiguous behaviors involving obnoxious submission and defiance, especially when interacting with the owner around contested boundaries and limits. The dog may become progressively demanding, clever, and evasive in the process of learning how to get around the owner's control efforts. Instead of learning how to defer and wait, under such circumstances, the intelligent dog learns to sneak and steal what it needs.

Dogs need a balance of dominance, leadership, and nurturance in order to form healthy social bonds with people and to develop well-adjusted behavior. In cases where social conflict is implicated as a potential factor underlying hyperactivity and intrusive excesses, efforts should be taken to promote a voluntary subordination strategy (see *Social Competition, Cooperation, Conflict, and Resentment* in Chapter 7) by means of reward-based training, play, and PFR training. Leadership is established by showing the dog how to succeed in its efforts to obtain reward and avoid punishment. The various points of disruptive social conflict and tension should be interpreted and explained to the owner in terms of potential sources of reward and opportunities for leadership and interactive growth. Rather than interfering with the dog's control efforts and needs, the goal of training is to show the dog how to get what it wants by following rules and cooperating with the owner's directives. Through cynopraxic training, the dog learns that the owner can help it to achieve control over its interests rather than represent an impediment standing in the way of them. Integrated compliance training (ICT) is used to attain these objectives. The ICT protocol integrates training activities with everyday sources of reward (e.g., food, play, affection, going outside, coming up on furniture, jumping up, and barking) in order to defuse and resolve interactive conflicts and tensions that have developed between the owner and the

dog around these activities. Reward-based ICT efforts improve owner control efforts, reduce social ambivilence (adverse anxiety and frustration), enhance affectionate bonding processes, promote interactive harmony and mutual appreciation, and restore trust and respect between the owner and the dog. As the interaction between the owner and the dog becomes more competent and cooperative, a spontaneous reduction in oppositional and intrusive behavior, adjunctive attention seeking, and hyperactivity naturally follows.

Conventional wisdom asserts that behavior maintained by intermittent reinforcement is more resistant to extinction than behavior maintained by continuous reinforcement. Intermittent reinforcement is a potent source of prediction error and dissonance. The process of reducing or omitting reinforcement (negative prediction error) for a variable number of times serves to set the stage for the occurrence of positive prediction error and reward when the reinforcer is again delivered. Many adjustment problems appear to be maintained by intermittent and inadvertent (bootleg) reinforcement, generally reducing the value of extinction as a behavior-control procedure (see *Extinction of Instrumental Learning* in Volume 1, Chapter 7). One way to address this problem is to first bring the target behavior under the control of continuous reinforcement before initiating the extinction procedure (Ducharme and Van Houten, 1994). Switching from intermittent to continuous reinforcement prior to extinction appears to reduce the baseline level of the inappropriate behavior while at the same time facilitating subsequent extinction efforts (Lerman et al., 1996). For example, in the case of jumping up, dogs can be rewarded each time they jump up until a noticeable flattening or decline in response frequency is observed (plateau), whereupon the behavior can be brought under stimulus control by rewarding only those jumping responses that occur in the presence of the jump-up signal ("Hup"). Jumping-up responses that occur off signal are ignored (extinguished) or blocked. The type, size, and frequency of attractive outcomes are varied to maximize surprise in association with jumping up on signal, thereby encouraging the dog to defer and wait for the signal giving it permission to jump up.

Jumping Up

Jumping up is among the most common behavioral complaints presented in association with hyperactivity. Often initially invited and permitted as an expression of affection, owners rapidly learn to regard this common greeting excess as a nuisance, particularly when large dogs persistently jump on unappreciative guests. Dogs that jump up represent a significant risk of injury to young children and elderly adults, who may be knocked down when bumped into or jumped on. Owners of such dogs are often forced to isolate their rowdy dogs when guests arrive—a procedure that may eventually generate more problems and do nothing to improve the dog's intrusive greeting behavior.

Early training consisting of sit-stay and other exercises promoting impulse control when the puppy seeks attention or other rewards helps to encourage more acceptable and organized social behavior. From an early age, jumping up and other intrusive social excesses should be limited, redirected, and brought under stimulus control. During greetings, the owner should crouch down or sit on the floor and allow the puppy to nuzzle and press in closely, but not permit it to climb up on the lap without an invitation. While sitting on the floor with the puppy, the owner can practice various basic obedience exercises (sit, down, and stand) using petting and treats to reward cooperative behavior prompted by voice and hand signals. Providing the puppy with an occasional opportunity to play tug and fetch with a ball or soft toy can help to redirect excessive energy into play activities and further encourage cooperative behavior. When the puppy is greeted from a standing position, stepping on the leash and diverting its attention toward the floor by dropping treats or tossing it a soft toy can help to prevent jumping up while simultaneously encouraging more desirable behavior (see below). Training the puppy to jump up and off again on cue can be a useful way to establish better control over the behavior. If

the puppy becomes overly aroused and excited, repeated brief TOs (30 seconds) can exert a pronounced de-arousing effect. Consistent discouragement of off-cue jumping up by turning away or by applying brief TOs serves to gradually weaken the puppy's enthusiasm for the habit. In general, the best results are obtained by shaping alternative behavior with reward and play rather than focusing excessively on suppressing undesirable behavior. Keeping in mind the dead-dog rule (see *Dead-dog Rule* in Volume 2, Chapter 2), training objectives involving jumping up should be organized in affirmative terms, that is, shaping alternative behaviors incompatible with jumping up rather than training the puppy not to jump up—dead dogs do not jump up.

Overly excitable and active puppies often benefit from PFR training. The postural control and taction techniques of PFR training are described in Appendix C. An abbreviated cycle of PFR training is initiated by taking the puppy by the collar and briefly massaging the jaw muscles, followed by the stand control, whereupon a focused and rhythmic massage is delivered on the neck and shoulder muscles. The massage should continue for 20 to 30 seconds before prompting the puppy to sit by gently squeezing just in front of the hip bones or by pressing forward behind the knees and guiding the puppy into the sit position. With the puppy sitting, the massage continues along its neck, spine, and lumbar areas. Next, the puppy's right leg is lifted up and forward from the elbow while it is gently and steadily lowered to the floor. The massage is continued in a calming and soothing manner. Lastly, the puppy is rolled over onto its side. Rubbing the jaw and temporal muscles can help to strengthen the relaxation response. Next, massage is directed toward the earflap, various muscled parts of the body, and the feet. As the puppy relaxes, the owner can present an odor (e.g., orange or lemon-orange mix) paired with the growing relaxation response. The puppy is released with an "Okay" and soft clap.

Controlling jumping up through extinction alone—that is, ignoring the dog or turning away from it—is not usually very effective. As a component of the greeting ritual, jumping up appears to be intrinsically reinforcing for dogs to perform. Also, given the adverse effects of periodic bootleg reinforcement and the impaired ability of hyperactive dogs to respond to extinction procedures makes procedures relying on extinction relatively ineffective for the control of hyperactive greeting excesses. The control difficulties arising in association with the intrinsic reward value of jumping up and intermittent reinforcement can remedied in four preferred ways:

1. Put the behavior on a continuous schedule of reinforcement and then bring it under stimulus control.
2. Block or correct jumping up whenever it occurs.
3. Teach the dog an alternative greeting behavior that pays off more than jumping up does.
4. Allow the dog to jump up as a reward for not jumping.

Training procedures often include all four methods of control applied in varying proportions as required by the situation and the needs of the dog.

Building improved attention and impulse control during greetings is facilitated by focusing training efforts on orienting and attending behaviors. The first step is to train the dog to reliably orient toward the trainer in response to hearing its name or the sound of a squeaker. If the dog fails to orient when its name is called, the squeaker or other sources of attention-grabbing stimulation (e.g., repeated smooch sounds) are used to evoke the orienting response. As soon as the dog turns its head, a click or "Good" bridge is delivered, followed by a food reward as the dog approaches the trainer. Next, the dog is trained to sit-front, look up, and hold eye contact with the trainer for variable periods (0.5 to 2 seconds) before the bridging signal and reward are delivered. After the food reward is delivered, the dog should remain in the sit position and wait to be released with an "Okay," whereupon the orienting, sit-front, and attending response are repeated. While the dog is waiting to be released, food rewards are delivered periodically contingent

on the dog looking up and making brief eye contact with the trainer. As the dog becomes steady in its ability to wait, a stay component can be added with the trainer maintaining eye contact as he or she steps back away from the dog. Numerous variations and elements of distraction and difficulty can be introduced to temper attention and impulse-control abilities (see Appendix A and Figure B.1A in Appendix B). Providing such training around the doorway establishes a useful platform for other reward-based training procedures used to control greeting excesses and other problems associated with greeting behavior.

Establishing control over excessive jumping behavior is facilitated by training dogs to jump up ("Hup"), to get off ("Off"), and to stay off ("Do you want this!") on cue. Dogs readily learn to jump up on signal after the behavior is brought under the influence of continuous reinforcement. Stimulus control is established by differentially reinforcing jumping responses that occur in the presence of the "Hup" signal and ignoring, blocking, or punishing (TO) jumping responses that occur in the absence of the signal. Off-cue jumping is associated with the vocal signal "Off," together with appropriate inhibitory prompts and rewards once the dog gets down. Impulse control associated with jumping up is significantly improved by using a challenge, especially at times when a dog is most likely to jump up off cue. The challenge serves to *dare* the dog to jump up, but without actually causing it to do so, whereupon the dog is rewarded for inhibiting the jumping-up response. The challenge consists of a prompt (e.g., slapping the legs or waist) that tempts the dog to jump up, together with a vocal signal delivered in an assertive tone of voice ("Do you want this!") belying the apparent invitation and causing the dog to hesitate. The dog's momentary hesitation is bridged and rewarded. This preemptive control procedure can be used to anticipate jumping up and promote a more reward-based approach to the problem. For example, when jumping up is highly probable, the owner can take the initiative by challenging the dog with the thigh or waist slap while saying "Do you want this!" Most dogs rapidly learn to hesitate in the presence of the challenge-dare, whereupon they are appropriately rewarded with affection, a treat, or an opportunity to jump up on signal. The challenge-dare is combined with other integrated compliance-training activities (waiting to go through doorways or to climb up and down stairs, sitting and staying for treats, waiting for permission to jump on furniture, and so forth). Such training is essential in cases where a habit of jumping up has been strongly established in a dog's greeting repertoire.

Staging actual greeting encounters with guests is a necessary part of retraining a problem jumper, but the first step is to train the jumper not to jump up on the owner during greetings. Most control efforts should be carried out with the dog on a leash. However, if the dog is off leash and jumps up, the owner should simply shout "Off!" and turn sharply away, thereby sloughing the dog off. Another method involves taking one or two steps backward and then stepping aside to throw the jumping dog off balance with a body block or sideways shove. Grasping the front paws momentarily and releasing them only after the dog struggles to break free can be effective (Mathews, 1983), but grasping the paws or legs should be done only in the case of dogs that are unlikely to mouth or bite as the result of such restraint. Alternatively, the legs can be grasped and the dog walked backward before shoving it off to the side with a reprimand "Off" delivered just as the paws are released. In any case, the dog should be immediately put on leash, whereupon directive control, challenges, response blocking, and TO procedures can be carried out in conjunction with the reward-based training of alternative behavior.

When greeting visitors, the dog should be kept on leash, giving the owner better control and the ability to apply response prevention and blocking (e.g., stepping on the leash) and TO procedures. Before opening the door, a treat (e.g., a small biscuit) is tossed, making a sharp tapping sound as it strikes the base of the door. As the dog takes the treat, the owner steps on the leash. Additional treats are dropped to the floor as the guest enters the house. Presenting noncontingent rewards during greetings generally has a calming effect on socially excitable dogs, perhaps by

evoking incompatible appetitive incentives that compete with social motivations driving greeting excesses. Treats may also perform an establishing operation function, thereby causing the dog to offer behavior that has been rewarded with food in the past. After receiving the noncontingent treats, the food can be withheld to reinforce sitting and waiting or presented according to a differential reinforcement of other behavior (DRO) schedule (see *Differential Reinforcement of Other Behavior* in Volume 1, Chapter 7). When using the DRO schedule, a bridged reward is delivered after a brief period (2 to 10 seconds initially), provided that the dog does not jump up. After establishing a control expectancy standard, the length of the DRO interval and the rewards given to the dog can be varied to produce better-than-expected and worse-than-expected outcomes (e.g., shorter DRO intervals or alterations of reward type and size), thereby mobilizing potent prediction-dissonance effects. Over time, the DRO schedule results in the strengthening of a varied spectrum of social behaviors that happen to occur coincidentally with the delivery of the bridge and reward. In general, presenting rewards in accordance with a DRO schedule is highly effective for managing and controlling the intrusive social excesses of highly excitable and active dogs at greetings, thereby reducing the need for punitive measures. Once intrusive greeting excesses are reduced via DRO and TO, a behavior incompatible with jumping up can be shaped (e.g., sitting or standing quietly) and reinforced according to a DRI schedule of reinforcement (see *Differential Reinforcement of Incompatible Behavior* in Volume 1, Chapter 7). Finally, because the doorbell often elicits intense conditioned preparatory arousal in association with greetings, it may be necessary to countercondition a new set of anticipatory emotions in response to the ringing of the doorbell. An electronic doorbell can be installed that allows the owner to ring the bell from inside the house. In addition to providing constructive counterconditioning effects, such an arrangement helps to shape and practice the various modules and routines needed to control the dog effectively during actual greetings.

For dogs that actively resist such training efforts and continue to jump up, an additional assertion of control may be necessary. With the dog on leash, it is caught midair and reprimanded "Off" and shoved to the side. The procedure is immediately followed by a "Do you want this" challenge and dare, and the dog is rewarded if it refrains from jumping up again. If, instead, the dog jumps up again, the reprimand "Enough!" and a directive leash prompt are delivered just as the dog jumps up, whereupon it is briskly removed to TO. During greetings, the dog is most effectively timed-out on the other side of the same door that the guest used to enter the house, with the leash pinched in the doorjamb. During the TO, the dog should be given enough slack to stand and sit comfortably but not be able to move around or lie down. After a brief TO (approximately 30 seconds), the dog is brought back inside and permitted to have close contact with the guest. If it jumps or becomes overly excited, the TO procedure is repeated, as necessary. With each TO, a significant decrease in arousal and jumping should be observed, thereby complementing DRO training efforts. If the dog jumps during DRO training, the response can be blocked by stepping on the leash or punished by additional TOs. Once the dog stops jumping, it is challenged (as described previously) and rewarded when it hesitates and inhibits the jumping response. After a few repetitions of TO, most dogs not only learn to inhibit the jumping response, they also learn to move away from the doorway as guests enter the house, perhaps in an effort to reduce the risk of being put outside. This method can be surprisingly effective with even the most recalcitrant jumpers. To further improve greeting behavior, the dog should learn to withdraw from the door by backing up as it is opened. This behavior can be mastered by practicing it before walks or whenever else the door is opened. If a treat is consistently tossed back from the door as it is opened, gradually the hand movement will become a signal controlling the backing or turning-away response. If necessary, the dog is directed away from the door with directive prompts. Before exiting the house, the dog should wait for a release signal to move

through the doorway. Training overactive and impulsive dogs to approach and to go through doors without pulling is an indispensable aspect of establishing control over greeting excesses. Dogs that charge through the door can be discouraged from the habit by bringing them to a dead halt and then closing the door on the leash and leaving them outside for 30 seconds, before bringing them back inside and repeating the procedure again.

Especially difficult dogs can be conditioned to stay within the area of a rug located near the entryway. Training the dog to go to the rug and stay on it should be accomplished to a high degree of reliability before it is used to control a dog around guests. The safe rug should be large enough for the dog to turn around without stepping off. During greetings, the dog should be kept under close supervision and restrained by leash and collar or halter in order to block or correct jumping attempts, whereupon the guest initiates a brief nonexclusionary TO by backing away from the dog. At the conclusion of the TO period, the guest approaches the dog again and continues to reward it with food and affectionate attention, so long as it does not become overly intrusive or jump up. Once the dog calms down, it can be released from the confinement area and permitted to move about more freely with the guest. If the dog jumps up, appropriate leash and physical prompts and exclusionary TOs are applied as needed to discourage the behavior. Throughout the process, frequent rewards are delivered on a DRO or DRI schedule in order to encourage and support more acceptable greeting behavior. In addition to performing sit-stay and down-stay training on the rug, PFR training can be performed on it as well, thereby developing a number of convergent associations conducive to impulse control and relaxation.

Once a dog has mastered the basic pattern of greeting without jumping, a variety of startle tools may be used to further strengthen the inhibition against jumping up. Most dogs can learn not to jump up without resorting to startle, but some may need such treatment to become fully compliant and reliable. For some dogs, tossing keys on the floor can be convenient and sufficient for such purposes, but other dogs may require a more impressive startle event. For example, the startling rattle produced by a seven- or 30-penny shaker can tossed to the floor can be highly effective. Ideally, the shaker can is tossed without the dog observing the action. As a result, merely tapping on the shaker can will often produce a potent inhibitory effect over the impulse to jump up. In the case of dogs possessing a high startle threshold, a brief burst of compressed air dispensed by a modified carbon-dioxide pump (with or without odorant) can produce a potent startle response, but the device needs to be used carefully to avoid overstimulating the dog (see *Modified Compressed-air Pump* in Chapter 2 for precautions). The delivery of compressed air should be concealed from the dog by applying it from behind or sprayed lightly under the jaw toward the ground: it should never be pointed and sprayed at the dog. A dilute odor sprayed from the nozzle of the pump will linger in the air and provide an olfactory reminder to the dog not to jump up again. As the result of olfactory conditioning, a squeaker bulb (without squeaking element) containing the odor can be subsequently used to deter jumping up. Presenting the conditioned odor appears to make other startle devices more effective via a startle-potentiating effect. Once sensitized to the hissing sound of the pump, a similar sound produced by blowing air between the tongue and front teeth may function as an effective warning. The use of devices producing extreme auditory startle or that risk damaging the ears of the dog or people standing nearby (e.g., a compressed nautical horn) should be avoided. Squirting the dog in the face with a spray bottle or squirt gun is not recommended, since it appears to promote undesirable avoidance behavior in many dogs. In some cases, the delivery of a dilute odor (e.g., orange or lemon-orange mix) from a working squeaker bulb can have a potent diversionary effect that is frequently sufficient to reduce jumping without needing to resort to more startling procedures. The presentation of the odor together with the squeaker sound appears to produce a strong momentary disrupting effect, but without generating significant startle, making the technique useful in the case of emotionally sensitive dogs.

In rare and extreme cases of persistent jumping that is not otherwise controllable, in cases where jumping-up behavior represents a significant threat of injury (e.g., to elderly dog owners), or in cases involving persons unable to perform the necessary leash controls and prompts, TO procedures, and so forth, the use of a remote electronic procedure may be warranted. Both chemical (citronella) and electrical devices are highly effective deterrents, but each requires proper introduction. Electrical collars require preliminary training that allows the dog to learn how to control the electrical stimulus (e-stimulus) by way of various exercises and response-enhancement procedures (see *Remote Electronic Training* in Chapter 10). Electronic training procedures should be used only after a dog has had sufficient instruction with reward-based procedures to understand what is expected. Electrical stimulation (ES) is primarily used to train a dog to back away from the door and remain away at some distance as a guest enters the house. Remote electrical training can be used to support training efforts to keep the dog on the safe rug during greetings. Throughout the process, the dog should receive frequent rewards in response to more desirable and cooperative greeting behavior. Although low-level and medium-level electrical stimulation (LLES and MLES) are unlikely to elicit aggression in a normal and friendly dog, nonetheless ES should not be delivered while a dog is in the act of jumping up or while it is in direct contact with a visitor. The close control of social excesses should be performed with a leash and collar or halter. An experienced and skilled trainer familiar with the risks and benefits of ES should supervise such training activity. Highly aversive ES in such circumstances is unwarranted and could result in undesirable fear, conflict, or the elicitation of pain-elicited aggression in predisposed dogs. Electronic and startle-producing devices should be used with the goal of providing a window of opportunity for additional reward-based training.

Barking

The causes underlying barking problems are varied, requiring that provoking situations, controlling antecedent variables (establishing operations), and contingencies of reinforcement be carefully identified and assessed. Many barking problems appear to be motivated by attention-seeking incentives, inappropriate or frustrated communication efforts, and a history of inadvertent reinforcement. Barking and other canine vocalizations are strongly influenced by heredity and perform a variety of species-typical communication functions (see *Barking, Motor Displays, and Autonomic Arousal* in Chapter 8). Barking activity is clearly increased by a history of positive reinforcement (Salzinger and Waller, 1962) and reduced by punishment. Many barking dogs have learned to place the gratification of their needs on demand: they may bark to go outside and to come back in, to demand food and its timely delivery, to badger the owner into playing with them, to wake the owner up in the morning or in the middle of the night (should they become lonely or bored), or to divert the owner's attention away from guests during greetings. An important aspect of training dogs not to bark is to remove the incentives to bark, that is, discontinuing the reinforcing consequences maintaining the barking behavior. Owners should discourage inappropriate barking and train their dogs to show more acceptable behaviors as a means to get what they want. Many barking problems can be managed or prevented by taking care to provide the dog with adequate daily exercise, training, and play. Defusing or redirecting heightened arousal into other activities (e.g., tossing the dog a soft toy or ball) or leaving it with a special toy or chew item when it is confined can significantly curb excessive barking. Many hyperactive dogs are insatiable enthusiasts for ball play. As the result of structured tug-and-fetch games, the ball can be made into a potent source of reward and diversion. Many hyperactive dogs prefer to have a ball in their mouth rather than bark, unless they happen to learn how to hold a ball and bark at the same time (not an uncommon canine skill). Aside from humor, the consolation in such cases is that at least the barking is muffled.

In active and excitable dogs, excessive barking may be evoked by environmental triggers having innate or species-typical signif-

icance, such as territorial intrusion, sudden movements, auditory startle, or the presence of animals beyond their reach (e.g., seeing a squirrel run across the lawn from a window). Such barking may occur independently of the owner's presence or absence. In many cases, barking appears to obtain reward from the effects it has on the object setting the occasion for the barking response. For example, barking at passersby or dogs roaming the neighborhood may be coincidentally reinforced when the target stimulus moves away—a change that reliably occurs when the dog barks, even though the action does not actually depend on the dog's barking response. Situations evocative of approach-avoidance conflict or frustration (e.g., fence lines shared with another dog) may generate high levels of barking. Finally, in situations involving more than one resident dog, barking excesses may develop as the result of social facilitation (see *Social Facilitation* in Volume 1, Chapter 7).

As in the case of jumping up, it is often useful to begin the training process by introducing attention and impulse-control training, thereby developing in advance strong orienting and attending responses, viable bridges (click and "Good" conditioning), a sit-stay module, and waiting behavior. Controlling excessive barking often involves bringing the nuisance barking behavior under stimulus control, that is, training the dog to bark on command (e.g., "Speak"). At first glance, such a training recommendation may seem odd to the average dog owner; nevertheless, it is a very effective means to help reduce unwanted barking. As a preliminary to stimulus-control training, barking is briefly put on a continuous schedule of reinforcement by clicking and rewarding barking behavior whenever it occurs. The instrumental barking module is then brought under the control of a vocal signal by saying "Speak" just as or before the dog barks, followed by the bridging signal and a food reward. Initially, the dog will bark both on cue and off cue, but as it learns that rewards are presented only when barking occurs in the presence of the vocal signal, barking off cue will gradually weaken as the result of extinction. In some cases, DRO training can be combined with stimulus-control efforts to help reduce excessive barking off cue. At the end of the DRO period, the bridge "Good" or a click is delivered with a food reward, provided that the dog has not barked. Alternatively, the dog can be prompted to bark on cue at the end of the DRO period. If the dog barks during the DRO period, the vocal signal "Enough" is delivered and the DRO period is reset or the dog is briefly timed-out. By combining DRO and stimulus-control training, the dog gradually learns that both waiting without barking and barking on cue results in positive reinforcement.

Exclusionary and nonexclusionary time-outs (TOs) can be useful when applied in the context of DRO and stimulus-control procedures. TO exerts the dual effects of reducing arousal and causing a dog to learn that barking leads to the loss of rewards and attention, whereas refraining from barking results in release from TO and their reinstatement. Barking that continues in TO can be gradually extinguished by ignoring it or by opening the door slightly and snatching upward on the leash with the reprimand "Enough." The TO should typically last 30 seconds, although longer TOs may be necessary for some dogs, but rarely more than 1 minute. After the 30-second TO, provided that the dog has not barked for at least 10 seconds, it is released with the vocal signal "Quiet" and returned to the evoking situation. For TO to be optimally effective, the training situation should be reward dense, making restraint and isolation unfavorable in comparison. If the training environment is excessively punitive, TO may not work as well or perhaps not work at all. In effect, under aversive circumstances, involving a high level of punishment and too little reward, TO from the situation may be experienced in terms of relief rather than punishment (see *How to Use Time-out* in Volume 1, Chapter 8).

While a dog is tethered, kept behind a gate, or crated, leaving the dog with a highly valued chew item or tossing it noncontingent rewards in accordance with a DRO procedure can often help to reduce excessive barking. In some cases, barking can be interrupted by

evoking an orienting response with the sound of a squeaker or whistle that has been strongly conditioned as orienting stimulus in the context of basic training activities. The cessation of barking is followed by a bridge ("Good" or click) and food reward, thereby linking the expectation of reward with orienting and the discontinuation of barking. Gradually, the vocal signal "Quiet" is paired with the orienting and bridging sequence. Although such techniques can help to frame, process, and modulate barking activity, the control attained by such means may not be reliable or durable. In most cases involving excessive and persistent barking, effective control requires an element of deterrence. The startle produced by a seven- or 30-penny shaker can is often sufficient to generate the necessary inhibitory effect. The shaker can is tossed in the direction of the barking dog so that it lands close enough to evoke a startle response, but not so close that it risks hitting the dog. Ideally, the dog should not see the trainer throw the can. After two or three tosses, the dog may show an inhibitory response to a brief rattle of the can alone. An alternative method involves arranging a drop can to fall nearby on the floor from the vantage of a remote location. The drop can is set up by tying a length of dental floss to the ring of a soda can and then passing the line through a small eyehook fastened to the ceiling. The line should be long enough to allow the owner to move away, even to a remote part of the house, as needed. Initially, the can is dropped onto the floor by releasing the line, whereupon it is hoisted up to the ceiling again by pulling the dental floss. After two or three sensitizing trials in which the can is dropped, a brief shake or slight movement of the suspended can is frequently enough stimulation to interrupt barking. The owner should periodically return to the confined dog to reward it with affection, food, and release, so long as it remains quiet during the period of confinement.

Barking problems that are under the influence of specific eliciting stimuli can be managed by altering the environment (stimulus-change procedure) or counterconditioning. By arranging the environment so that provocative stimulation is prevented from reaching the dog (e.g., keeping windows closed and blinds shut that face on the street), the amount of daily barking can be substantially reduced. If the barking problem primarily occurs outdoors, bringing the dog indoors when the provoking stimulus is present also helps to reduce frequency and duration of barking episodes. Bringing the dog inside at such times may function as a TO event, thereby potentially helping to reduce future barking activity. In situations where environmental conditions cannot be changed, bark-provoking stimulation may be responsive to counterconditioning efforts. Counterconditioning is performed by pairing bark-eliciting stimuli with food or other sources of incompatible stimulation, thereby producing new associations and raising the bark threshold. For example, ringing the doorbell and immediately throwing a piece of food toward the door can gradually help to reduce excessive barking associated with greetings. The counterconditioning effect is augmented by repeated trials in which the size and type of the food treat are varied from trial to trial. Counterconditioning can be combined with a variety of instrumental training techniques, including DRO, stimulus control, and shaping procedures, whereby more appropriate behavior is strengthened and brought under control with positive reinforcement.

Barking excesses that occur outdoors or when the owner is not present pose significant challenges. Dogs that bark when outdoors should be trained to orient to a whistle and come when called (see *Recall Training* in Chapter 1), whereupon they are released and diverted into some other activity (e.g., ball play). Barking that takes place while the dog is alone is most frequently treated with bark-activated deterrents (see below). However, an automated application of the orienting and DRO procedures previously described might be useful in some cases of barking nuisances occurring in the owner's absence. A signaling and feeding device could be programmed to deliver an alerting stimulus whenever the dog barks, followed by a bridge and a small predictable reward when the dog stops barking in the presence of the signal. The device could

also be programmed to deliver a better and varied reward in accordance with a variable DRO schedule, with the bridge and food reward automatically occurring after some period of time, provided that the dog does not bark. After a number of successful DRO trials, indicating that the barking episode is over, the program could automatically reset. In addition to reward-based procedures, remote and bark-activated punishment and avoidance training can be useful (see *Electrical Stimulation and Excessive Barking* in Chapter 9). Although both bark-activated citronella and electronic collars can be effectively used to suppress barking excesses (Juarbe-Diaz and Houpt, 1996), citronella-type collars appear to be more prone to habituation effects, a factor that may limit their usefulness in situations involving repeated bark-provoking stimulation (Wells, 2001). Barking excesses associated with fear, aggression, and separation distress need to be appropriately assessed and addressed with suitable behavior therapy procedures, with remote or behavior-activated devices being used cautiously in such cases, if at all.

Excessive Attention-seeking, Begging, and Demanding Behavior

The causes of excessive attention-seeking behavior are varied, and each case requires individual assessment and evaluation before deciding on a course of treatment. Attention-seeking excesses may stem from exercise deficits, excessive confinement, social deprivation, interactive conflict and adjunctive influences, inappropriate social stimulation, or inadvertent reinforcement. A close phenomenological relationship appears to exist between attention-seeking and active-submission behavior (see *Attention Seeking* and *Adjunctive Generation of Hyperactivity* in Volume 2, Chapter 5). Many dogs that exhibit attention-seeking and intrusive excesses are often prevented from sleeping in the company of family members—a potentially significant etiological factor. Simply allowing the dog to sleep in a bedroom, providing it with more exercise, and developing a daily play and training routine often results in a rapid reduction of inappropriate attention-seeking behavior. Many overactive and excitable dogs exhibit impaired abilities to exert inhibitory control over stimulation-seeking impulses. Seeking behavior in such dogs may be dysfunctional, operating independently of normal inhibitory regulation, consummatory objectives, and reward gratification. Instead of being satisfied with the acquisition of the reward object and stopping, such dogs repeatedly entrain the seeking sequence without appearing to obtain gratification. Although punishment may momentarily blunt the seeking excesses exhibited by such dogs, the punished behavior often rapidly recovers or actually increases over time. Attempting to directly punish or extinguish modal activity without providing adequate alternative outlets is highly problematic (see *Autonomic Arousal, Drive, and Action Modes* in Chapter 10). Although control modules and routines associated with modal seeking (i.e., searching for drive-activating stimulation) can be extinguished, the modal-seeking propensity itself is highly resilient and relatively immune to the consequent effects of risk and loss. The mismanagement of normal attention-seeking and proximity-seeking behavior with positive and negative punishment may produce significant social conflict (affection-fear) and exaggerated active-submission behavior in the dog. A natural outlet for attention-seeking excesses is provided by play, especially play activities consisting of a balance of competitive and cooperative components (e.g., tug and fetch). Play integrates the active-submission aspect of attention seeking and gives it purposeful direction and function, helps to reduce social conflict, and provides an active modality for supporting basic training activities.

Attention seeking and begging behavior appear to be governed by a shared set of stimulation-seeking incentives. Like distractions, which really amount to environmental reinforcers not yet under the trainer's control, begging and demanding behavior reflect motivational states not adequately directed toward the enhancement of cynopraxic goals. Just as one may introduce and use attractive environmental stimuli (distractions) as contingent reinforcers to support training objec-

tives, begging and demanding behavior point to appetitive and social rewards not yet in the service of more cooperative behavior. From this perspective, attention seeking and begging (active-submission behaviors) are nuisances only to the extent that they have not yet been constructively redirected into more acceptable outlets. Just as environmental distractions represent a source of untapped reward for future training efforts, socially intrusive behaviors represent untapped opportunities for reward-based training activities. Training gives active submission (that is, attention seeking and begging) leadership and direction via nurturance. Many hyperactive dogs are simply *seeking and begging* for human leadership. Dogs of this nature are typically highly responsive to play-based and reward-based training efforts. When combined with appropriate limit setting and directive training efforts, play and reward training can be highly successful and should be earnestly encouraged in such cases.

Dogs appear to possess an innate tendency for begging, species-typical behavior that may have aided their survival as they became dependent on humans for food. As a result, begging is highly prepared and rapidly conditioned. By occasionally giving a dog food from the table, it may gradually learn to beg and subsequently develop various other pestering behaviors in other situations. As a nuisance, begging is a modal strategy that develops under the influence of a variable duration (VD) schedule of intermittent reinforcement and an element of punishment. A VD schedule provides reinforcement after the target behavior has occurred continuously for a variable length of time. VD schedules promote hopeful persistence via positive and negative prediction errors. Begging commonly produces two sources of significant positive prediction error: sooner than expected and better than expected outcomes. Demanding behavior operates under the influence of a similar prediction dissonance, but usually without a significant history of punishment. Hope, as a concomitant emotion associated with VD schedules, appears to be an outcome or function of a dynamic history of surprise (success) and disappointment (failure) occurring as the result of begging (see *Hope, Disappointment, and Other Emotions Associated with Learning* in Volume 1, Chapter 7). Hope facilitates the continuation of behavior in the face of suboptimal reinforcement conditions and punitive contingencies, with the expectation that the conditions of reinforcement will eventually change, as they have in the past. Under the influence of hope, frustration and fear are restrained, perhaps explaining the resistance of begging behavior to extinction and punishment efforts. Introducing an alternative modal strategy is the best way to control excessive begging. Such training usually involves a strong component of integrated compliance training, whereby the dog learns to earn attention and food and other everyday rewards by means of deferring, waiting, and cooperating. Instead of allowing the dog to get attention and food as the result of begging, the dog is trained to leave the situation, lie down, and stay (see *Go-lie-down* in Chapter 1). After a variable period of time, the dog is rewarded with food, affection, or release from the down-stay. During the early stages of training the go-lie-down routine, the dog is often put on an active-control line to facilitate the moving-away response and staying at a distance. The active-control line allows the owner to direct the dog away from the table without needing to get up—a feature that is particularly useful at dinnertime. To help prevent begging problems, dogs should not be fed from the table or other locations associated with food preparation.

NUISANCE OR GEM IN THE ROUGH

Dogs that exhibit an intense and persistent interest in social contact, appetitive and social rewards, and play activities, such as retrieving games and finding hidden objects, are often gems in the rough waiting to be developed. These highly active, sociable, and curious sanguine extroverts are in an almost constant state of readiness to work and play, which really amount to the same thing for them. Although tending toward excessive and impulsive behavior, such dogs are able to learn self-control and to behave in cooperative ways, provided that such training exploits

their drive to play and their exaggerated predilection for social and appetitive stimulation. The athletic drive and energy, playfulness, and *obsessive* single-mindedness of such dogs are often misinterpreted and mismanaged. As a result, many of these dogs remain gems in the rough or become gems lost to neglect or abuse because of mishandling or inappropriate training or punishment efforts. To succeed with such dogs, their behavioral potential needs to be actualized rather then suppressed, while at the same time shaping social behavior and skills compatible with domestic expectations.

Dogs of this sort are essentially normal, and there are no drugs or behavioral protocols that can transmute this sort of living gold into a baser substance without simultaneously destroying it. For dogs born to leap at life with passion, being trapped in a home with little appreciation or understanding of such a dog's capabilities and needs is simply a tragic state of affairs having significant welfare implications. From the perspective of many dog owners, however, the behavior of such dogs is an unbearable nuisance that is frequently treated in the worst possible ways. As a result, such dogs may develop a variety of secondary behavior problems that further complicate things, making their lives even more untenable and miserable. Owners living with these spirited sanguine-type dogs must truly accept the challenges associated with their training and exhibit a sincere appreciation of the extraordinary potential that such dogs represent; otherwise, hard decisions might need to be made. In situations in which an owner is unwilling to provide the sort of conscientious training and nurturance required to socialize and train such a dog properly, serious consideration should be given to counseling the owner to rehome the dog.

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6

Neurobiology and Development of Aggression

PART 1: EVOLUTION AND NEUROBIOLOGY

Competition and aggression are virtually universal among highly evolved social animals.

The wide phylogenetic distribution and prominence of competition and aggression among social animals attests to their adaptive value. Although competition and aggression are of tremendous value for enhancing reproductive fitness and survival, excessive competition and aggression are risky and waste energy. Consequently, animals have evolved various means for regulating agonistic interaction in order to maximize benefits and minimize costs.

DOMINANCE AND THE REGULATION OF AGGRESSION

Of particular importance is the evolution of communication systems. Dogs have evolved a wide variety of social signals, displays, and rituals involving every sensory modality in order to exchange information and communicate (see *Communication and the Regulation of Social Behavior*, Volume 1, Chapter 10). An important function of social communication is to limit competition and prevent overt aggression. Various strategies have evolved to regulate aggressive tensions arising between individuals belonging to the same group as well as reducing competition between groups living in the same general area. Competition between individuals belonging to the same social group is regulated by the formation of hierarchically organized dominant and subordinate relations based on outcomes resulting from past competitive exchanges and contests. As a result of accumulated competitive successes or failures, group members take on various dominant or subordinate roles, consisting of attitudes and social behaviors consistent with their social rank. Social rank is advertised by the exchange and observance of social rituals consisting of threat and appeasement displays, the formation and exercise of stabilizing social alliances, and numerous other complex social customs (e.g., greeting and play behaviors) (Figure 6.1). An important function of threat and appeasement displays is to make competitive interaction more predictable and less socially disruptive and violent, thereby setting the framework for more cooperative interaction based on mutual tolerance and affiliative partnering. In well-organized and friendly groups competition is redirected into cooperative ventures serving the mutual interests of both dominant and subordinate group members. However, failure to observe the rules of dominance and priority (e.g., reproductive rights) may prompt pun-

FIG. 6.1. Wolves exchange a variety of threat and appeasement displays in the process of establishing and maintaining a dominance hierarchy. Alliances between pack members are formed to stabilize the status structure and to promote peaceful and cooperative member relations. The display of direct eye contact and other gross and subtle expressions of rank causes a subordinate to avert eye contact, lower ears, and display an appeasement lick—behaviors that are also exhibited by dogs in response to assertions of social dominance. (Photos courtesy of Monty Sloan and Wolf Park, www.wolfpark.org.)

ishment in the form of strong aggressive threats or overt attacks.

Coevolution, Play, Communication, and Aggression

The concepts of social dominance and territorial defense are often suggested to help explain aggressive behavior in dogs, especially aggression directed against humans. This is a subject of considerable complexity and controversy that has been discussed at some length in Volume 2 (see *Dominance and Social Harmony* in Chapter 7). Of course, competition between humans and dogs occurs, occasionally escalating into overt aggression, but the causes of aggression are not limited to dominance-related ones (see *Antipredatory Strategy and Autoprotection versus Dominance* in Chapter 8). The relationship between humans and dogs is unique and of a different order than the relationship between dogs. Just as humans view and treat dogs differently than they treat other humans, dogs appear to have evolved specialized behaviors facilitating enhanced affiliative partnerships with human companions, often appearing to prefer contact with humans over dogs (see (see *Supernormal Attachment Hypothesis* in Volume 2, Chapter 4). Dogs have been lifted out of nature and placed into the human family by a transformative process of artificial selection, socialization, and training. Over the course of the dog's domestication, powerful evolutionary influences appear to have mutually altered both human and canine behavior and our propensity for close affiliation with each other. As dogs and humans engaged in convergent hunting activities aimed at exploiting similar food resources, their ability to cooperate and communicate with each other probably underwent significant change. In addition to evolutionary convergence, humans and dogs may have been brought into closer affinity as the result of coevolutionary pressures selecting for social propensities and roles that enhanced their cooperation and biological fitness. Coevolution presupposes the existence of reciprocal selection pressures such that the evolution of one species is partially dependent on the evolution of another species. The close historical interaction between dogs and people seems to fulfill this requirement. Cooperative hunting and many other uses made of dogs may have exerted pronounced coevolutionary pressures gradually making dogs more like humans and humans more like dogs (Schleidt, 1999; Taçon and Pardoe, 2002). Schleidt (1998) has argued that the wolf's highly developed packing behavior, involving cooperation, risk sharing among pack members, pair bonding, and affiliative partnerships among like-gendered individuals, enabled wolves to move to the top of the food chain. By adopting wolflike social habits, Schleidt argues, early humans may have obtained a variety of advantages that enabled them to diversify survival strategies, thus becoming better equipped to exploit nature and coevolving together with the dog rise to a heightened position of power and social complexity.

Play and Affiliation

Under the influence of coevolution, humans and dogs appear to have brought play to a high level of expression. The augmented ability of humans and dogs to initiate and sustain play activities appears to be an essential trait mediating cooperative activity as well as enhancing our desire to stay in close proximity with each other. Perhaps, in the absence of the rigors and travail attendant to surviving under natural conditions, play takes on an ascendant trajectory relative to other more serious activities aimed at self-preservation. The home provides a high degree of safety and security and is highly conducive to play. Play is the living meaning and essence of the human-dog relationship; without play, there is nothing much of value left over to maintain a connected, harmonious, and friendly relationship. Play is forgiving and mediates affectionate tolerance by various means. Play contextualizes actions and exchanges in a way that *in-earnest* implications are overshadowed by an *in-fun* interpretation and abiding trust that all is just play and not what it might otherwise denote under more serious circumstances. Playful contextualization helps smooth over our mutual failings to communicate unambiguously in the language of the

other species, thereby installing an affiliative bias of trust that competes with other possible interpretations that might lead otherwise to socially disruptive behavior, including aggression. Play allows humans and dogs to interact and enjoy each other without worrying too much about the implications of interactive vagaries or ambiguous communication. Play nurtures social trust and tolerance within the context of the home. The dog's normal environment—the home—selects for playfulness, just as humans tend to select mates based on such things as a good sense of humor.

Paedomorphosis, Dependency, and Affection

In addition to playfulness, a number of other evolutionary changes occurring over the course of the dog's domestication have combined to enhance the dog's ability to bond, cooperate, and coexist peacefully with humans. These various changes are often collected under the heading of *paedomorphosis*, an evolutionary process in which youthful morphological and behavioral characteristics are retained into adulthood (see *Paedomorphosis* in Volume 1, Chapter 1). In addition to increased playfulness and dependent behavior, behavioral thresholds controlling fear and aggression have undergone significant alteration (Gariépy et al., 2001), making close interaction and affiliative partnering between humans and dogs possible. As a result of these various biobehavioral changes, dogs have generally become more tame and docile, submissive, and dependent on humans, making dogs more adaptable and responsive to human behavioral control efforts. Dogs appear to crave human contact and attention, exhibiting a comparable response to petting and praise as they do to the presentation of food as a reward for cooperative behavior (Fonberg et al., 1981). Tactile gratification and willing submission to human authority are highly prepared propensities in the vast majority of dogs. Dogs appear to be equipped with specialized adaptations that enable them to cope effectively with social stressors. Many dogs are so docile and compliant that they will endure intense physical pain and threatening restraint without resorting to aggression, and those that do attack often do so in an inhibited sort of way. In general, dogs appear to be biologically prepared to exhibit dependent, cooperative, and submissive behavior and inhibit disruptive competition and aggression toward humans. Perhaps, most significantly, with respect to the dog's tolerance for aversive stimulation and readiness to submit, is an innate and socially actualized propensity to recognize humans as a source of safety and comfort.

Enhanced Communication Abilities

In addition to docility, dependency, and playfulness, dogs are highly responsive to human communication—a propensity that enables them to form close cooperative bonds and work under the direction of people in a wide variety of occupations. Most dogs appear to assign meaning to human actions; that is, they view much of what we do in relation to them as having significance and value as information (Soproni et al., 2001). Dogs have been shown to exhibit a pronounced ability to follow directional cues provided by gaze, pointing, and attend to extremely subtle movements (see *Nora, Roger, and Fellow: Extraordinary Dogs* in Volume 1, Chapter 4) (Candland, 1993). Further, although dogs possessing a propensity for playful environmental exploration are capable of independent problem solving of a high order (Sarris, 1938–1939), they are apt to defer to human guidance rather than rely on their own initiative to solve problems when a human is present (Topál et al., 1997). As a result of their enhanced dependency and reliance on human guidance, dogs appear to have acquired a highly sensitive faculty for responding to and giving directional cues. Dogs use a variety of human signals (e.g., pointing, bowing, head nodding, head turning, and gaze) to locate hidden food (Miklósi et al., 1998; Hare and Tomasello, 1999). Well-socialized dogs are also capable of getting us to help them solve problems by employing various *showing* strategies, whereby they simultaneously attract our attention and direct it to some object or place of interest (Miklósi et al., 2000). Showing is accomplished by bodily orientation and gaze alternation in which

dogs look back and forth between the owner and the place or object of interest. Dogs often combine gaze alternation with vocalization, apparently in an effort to capture and direct the owner's attention to the object or activity of interest. For example, dogs commonly engage in showing behavior, when they want to go outside to play or relieve themselves, by barking or alternately looking at the owner and glancing toward the door or leash hanging on a hook.

A dog's ability to exploit human attention as something to use to achieve private ends, together with its ability to follow human directional cues accurately, suggest the existence of a high degree of social attunement and appreciation of humans as a source of information and environmental control. Dogs appear to be cognizant of the functional significance of attention as a means to enhance their control over the environment, perhaps reflecting an underlying evolutionary change associated with domestication, whereby assessment of information (attention) and intelligent hesitation (impulse control) are brought to the forefront, while spontaneous instinctive action, depending on the activation of innate releasing mechanisms, is pushed into the background. By becoming reliant on attention and impulse control, dogs are exposed to a double-edged sword offering great potential for benefit or harm (see *Locus of Neurotogenesis* in Volume 1, Chapter 9). Behavior regulated by attention and impulse control may be highly adaptable and effective in environments that are relatively predictable and controllable; however, if the environment is deranged, then dogs risk experiencing high levels of anxiety and frustration, potentially leading to increased irritability, intolerance, emotional and behavioral reactivity, and disorganization.

Emotional Command Systems and Drive Theory

Panksepp (1982 and 1998) has described four major emotional command systems mediating behavior: seeking, fear, panic, and rage (Figure 6.2). These various emotional command systems share modulatory interconnections that interact to mediate adaptive behavior. Emotional balance and organized activity are achieved by the complementary excitatory and inhibitory influences produced by these various systems working together in relative harmony. For example, the seeking system is influenced by positive incentives and appetitive behavior, activities that becomes less active as the result of satiation (feedback) or as the result of inhibitory influences produced by other emotional systems. Activation of the fear and rage system exerts a strong inhibitory effect on the seeking system; for example, fearful or enraged dogs typically refuse food. Also, fearful dogs are less likely to explore the environment for reward, but may become highly vigilant for signals of punishment. Under the influence of conflict-related stress, the seeking-rage axis may become progressively disorganized [unstable extravert (choleric or c type)] and susceptible to frustration-related compulsions (e.g., tail chasing) and aggression problems. On the other hand, the stressful activation of the fear-panic axis [unstable introvert (melancholic or m type)] may result in increased phobic reactivity, separation distress, and anxiety-related compulsions (e.g., excessive licking) (see *Inclusion Criteria* in Chapter 5).

Drive as a Higher-order Class of Behavior

Panksepp's emotional command systems closely correspond to the basic components of drive theory. According to drive theory, dog behavior can be divided into four interconnected primary drives: prey drive (social bonding/seeking system), social drive (panic system), defense drive (fear system), and fight drive (rage system). Drive pertains to a higher-order class of behavior containing a set of sequences or routines sharing a common motivational substrate and function (see *Higher-order Classes of Behavior* in Volume 1, Chapter 7). The nature of drive as a higher-order class of behavior denotes broad scope and biogenetic significance. In contrast to simple reflexive behaviors that are elicited by conditioned and unconditioned stimuli, drive-related behavior consists of complex species-typical sequences and routines that are educed (from Middle English *educen*, to direct the flow of; also, Latin *educere*, to lead)

and guided into expressions and form. Behaviors belonging to the same class are normally educed by a common set of learned or innate triggers subserving the drive function. For example, behaviors belonging to the higher-order class subsumed under the prey drive share with one another (among other things) the motivation to chase and grab moving things. The performance of drive-related behavior is frequently intrinsically reinforcing for dogs; for example, finding and taking food or detecting and escaping/avoiding a threat are strong sources of reward. Drive activities possessing less tangible sources of gratification are also often highly reinforcing for dogs to perform (e.g., chasing a ball or playing tug games).

Social play is a special modal activity wherein integrative projects are rapidly exchanged between play partners to produce

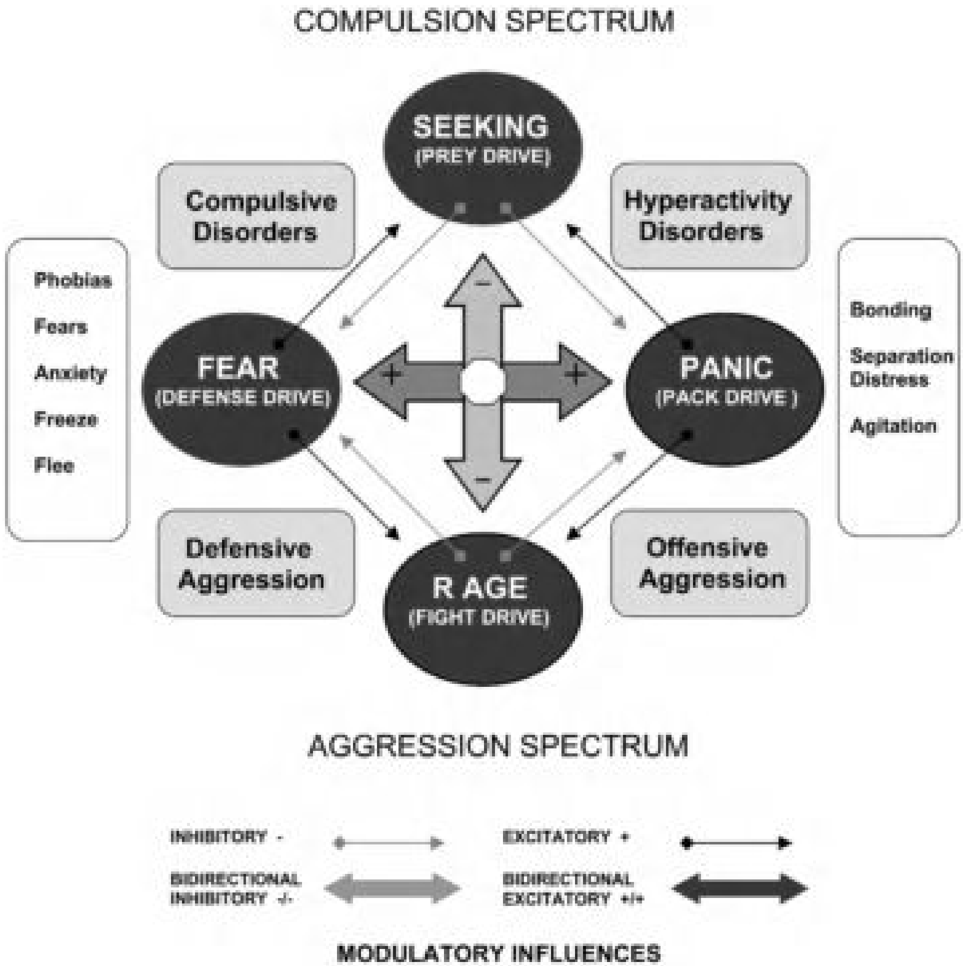

FIG. 6.2. Drive and emotional command system. According to Panksepp, behavior is under the influence of four interactive emotional command systems involving fear, seeking, panic, and rage. Panksepp's emotional command systems closely correspond to the traditional drive or instinct systems ascribed to dog behavior by trainers (see Most, 1910/1955). The activation of these various systems exerts an excitatory or inhibitory effect on other systems. The seeking and rage systems exert a reciprocal inhibitory effect, whereas fear and panic produce a reciprocal excitatory effect. Panksepp's system provides a framework of scientifically validated neurobiological influences for understanding the dynamic interrelations between emotional systems and the expression of adaptive and aberrant behavior.

mutual surprise and excitement conducive to elation and joy. Play-guided training exerts pronounced influences on the expression and form of drive-related behavior. Under the influence of ludic-establishing operations (see *Establishing Operations* in Chapter 1), sequences of behavior belonging to one drive class can be linked with behavior belonging to other drive systems, resulting in unique combinations and forms. Through the agency of play and conditioning, predatory sequences may be educed in combination with a variety of other behaviors belonging to other drive systems (e.g., social, defense, and fight). This process is most plainly apparent in the training of working dogs, whereby innate drive systems and behaviors from diverse origins are combined and harmonized into functionally useful routines via the combined influences of play, drive eduction, and conditioning. *Drive conditioning* refers to a process whereby drive-related activities are progressively focused, refined, redirected, or suppressed via the educement of other drives. The training process serves to shape and playfully entrain drive-related behaviors under the influence of ludic-establishing operations, giving their performance a high degree of intrinsic reward value for dogs. Behavioral thresholds controlling the eduction of drive-related behaviors are affected by both biogenetic and ontogenetic influences. As a whole, an individual dog's propensity to behave in drive and the behavioral thresholds controlling the eduction of drive activity are the elemental dimensions of a dog's temperament. In addition, a dog's trainability is determined by its capacity for playful drive eduction and the entrainment of the drive-related behavior needed to serve the training objective. From the cynopraxic point of view, training incorporates play and drive eduction as a source of intrinsic motivation with the purpose of actualizing a dog's potential and enhancing the human-dog relationship. Play is the substance and means to attain cynopraxic joy.

Drive Systems, Aggression, and Behavior Problems

The seeking system or prey drive consists of appetitive activities involved in searching for food (hunting and tracking), capturing and killing prey, and feeding. The searching system is also involved in the mediation of various grooming (self-stimulatory) activities (e.g., licking, scratching, and biting). The seeking system recruits various forms of locomotor activities (walking, running, stalking chasing, pouncing, and shaking) and sensory modalities (visual, olfactory, and auditory). Seeking behavior is controlled by a variety of reflexive and positive incentive systems influencing environmental exploration, excitement, and learning. When the seeking system is suppressed, its ability to restrain fear, panic, and rage may be impeded. Bilateral ablation of the olfactory bulbs results in increased emotional reactivity and aggressive behavior, suggesting that olfactory tracts projecting to the amygdala and hypothalamus may perform an inhibitory function over excessive emotional and aggressive arousal (Cheal and Sprott, 1971). This finding is consistent with the general inhibitory effect that the seeking system is believed to exert over the rage system.

Preparatory behaviors (e.g., sniffing, scanning, searching, and stalking) belonging to the prey drive system are under the influence of a positive feedback mechanism that makes their performance intrinsically reinforcing for dogs. Working dogs that track persons or search for hidden substances may be motivated to continue despite adverse reinforcement conditions because the olfactory incentive system keeps them going in the absence of immediate extrinsic rewards (see *Autonomic Arousal, Drive, and Action Modes* in Chapter 10). Under the influence of stress associated with excessive conflict or frustration, the seeking system may become pathologically overactive, leading to various disorders associated with behavioral excess and impulsivity (e.g., hyperactivity and compulsions). The seeking system is under the opposing or inhibitory influence of the rage system or fight drive. The axis between seeking and rage normally mediates reciprocal inhibition, keeping both systems in relative balance and stability. Under adverse conditions, the seeking-rage system may become unstable and disordered, perhaps by forming disruptive excitatory interconnections with fear and panic systems.

The fear system (defense drive) mediates escape/avoidance behavior (freezing and fleeing). The panic system (social drive) is activated by loss of social contact (separation distress) and is associated with agitation and intense care- and proximity-seeking behavior.

In addition to mediating reactive separation distress following the loss of social contact, the panic system is activated by the loss of social safety and trust. The axis between the panic and rage systems appears to mediate offensive aggression via the evocation of anger (see *Loss of Safety, Depression, Panic, and Aggression* in Chapter 7). Frustration and irritation preferentially arouse the rage system, triggering affective attack, biting, and fighting. A prominent factor associated with owner-directed aggression appears to be conflict associated with the loss of safety. Owners, as both attachment figures and disciplinarians, are prone to represent some degree of conflict to dogs. Normally, dogs are reared with a significant amount of training and exposure to varying degrees of aversive handling and stimulation that prepares them to cope with adversity at the hands of owners without losing their trust or sense of safety. However, in some cases, involving a history of aversive stimulation resulting in the evocation of significant physical discomfort (irritability) or repeated resource loss (frustration), heightened levels of conflict and loss of social safety and trust may ensue. Alternatively, and perhaps more frequently, dogs that have been raised permissively and indulgently, having not been properly socialized and habituated to the adversities and vicissitudes of social life, may overreact to minor intrusions, as if their social safety and trust toward the owner had been violated. And, of course, it has been violated, at least with respect to the dog's expectations of safe and trusting interaction. As the result of excessive dependency, such dogs may be especially vulnerable to panic-anger conflict in response to the owner's relatively innocuous intrusions. Many of these dogs have never been physically punished in their lives. Aversive stimulation, which obviously is relative, at the hands of a familiar and affectionate attachment figure may generate significant panic-anger conflict and autonomic arousal that, in some cases, may result in panic-evoked aggression. Although familiarity and affection are natural and powerful inhibitors of aggression, insofar as they promote social safety and security (trust), they also appear to represent the necessary conditions for panic-evoked aggression. The sufficient condition for panic-evoked aggression is a violation of trust and a loss of social safety. Dominance-related aggression frequently is exhibited in ways that are consistent with a panic-evoked scenario in which the bond between the owner and the dog is threatened by a loss of safety and trust. Fear-related aggression, on the other hand, does not depend on social familiarity, but results in situations in which preferred escape or avoidance actions are blocked or unavailable. If successful, fear-related aggression may become a preferred means to control similar threats in the future. Approach-avoidance conflict associated with strangers and territorial transitions is prone to evoke defensive aggression (e.g., bark threats, lunging, and snapping).

In combination, these various emotional command systems and the neural circuits supporting their activity have evolved under environmental and social pressures held relatively constant over the course of the dog's phylogenetic history. Appropriate species-typical behavior patterns (instinctive activities) are intimately related to these emotional systems and their activation. The natural triggers activating command or drive systems are strongly influenced by genetically encoded thresholds and self-regulating feedback mechanisms. In addition to activation resulting from unconditioned stimulation, emotional command systems may be brought under the selective control of novel triggers or conditioned stimuli as the result of classical conditioning. Although behavioral thresholds are strongly influenced by biogenetic factors, the excitatory and inhibitory thresholds controlling drive-related behavior are variable and responsive to modification and modulation through learning. Hunger, pain, thermal extremes, fatigue, and other sources of biological need produce significant modulatory influences over emotional drive systems. Chronic and acute stress can exert a particularly pervasive effect on the conditioned and unconditioned excitation or inhibition of emotional command systems.

Under the influence of acute and chronic emotional stress, the various thresholds controlling the seeking, panic, rage, and fear command systems may undergo significant change, making behavior dependent on those systems more unstable and disorganized. Stress, however, also exerts highly beneficial and adaptive effects on behavioral thresholds and learning. Upon recognizing that a disjunction exists between what the dog expects to occur and what occurs in fact, surprise or startle is evoked, enhancing its attention to the event and increasing its readiness for behavioral change. Surprise and startle mediate significant modulatory influences over trigger thresholds controlling emotional activity. In the case of surprise, fear and rage thresholds may be significantly elevated, whereas seeking thresholds may be lowered and activated in order to exploit the unexpected resource maximally. On the other hand, startle may elevate seeking thresholds while lowering fear, panic, and rage thresholds, depending on the sort of trigger stimulus involved. Beneficial stress associated with startle may help the animal escape or avoid dangerous situations by rapidly lowering thresholds of emotional command circuits controlling species-typical defensive reactions (see *Species-specific Defensive Reactions and Avoidance Training* in Volume 1, Chapter 8). In both cases, the alteration of emotional thresholds serves to compel the animal into specific courses of action, defining in advance the sort of behaviors most likely to occur and to undergo reinforcement if they do occur (see *Antecedent Control: Establishing Operations and Discriminative Stimuli* in Volume 1, Chapter 7). However, under stressful circumstances in which the dog's normal coping efforts fail because of environmental or social constraints, emotionally reactive and unorganized behavior may emerge.

Cognition and Emotional Command Systems

Emotional command systems are modulated by cortical control systems that process experience and prepare dogs to act in ways consistent with past experience on ongoing events. Under optimal conditions, prediction-control expectancies are formed that promote adaptive behavior, but, under the influence of disorderly environments, faulty expectancies and dysfunctional behavior may develop. Particularly malignant influences may originate in traumatic events or result from habitual exposure to social and environmental events that lack adequate predictability (resulting in anxiety) or controllability (resulting in frustration). A lack of predictability over significant appetitive and aversive events may disrupt emotional activity associated with the fear-panic axis, possibly contributing to the development of phobias, compulsive disorders, and separation problems. On the other hand, a routine lack of controllability over significant events may adversely affect activities mediated by emotional circuits associated with the seeking-rage axis, perhaps playing a role in the etiology of various forms of affective aggression and behavioral excesses. When behavioral events are relatively predictable and controllable, emotional command systems function optimally to promote adaptive behavior and a better state of being. However, when behavioral events occur independently of a dog's ability to predict or control them, then various pervasive cognitive and behavioral perturbations may follow (see *Learned Helplessness* in Volume 1, Chapter 9). Another source of disturbance is the conflict resulting from the simultaneous activation of incompatible emotional command systems by the same stimulus—a common occurrence in the case of severe and unpredictable punishment, whereby the owner becomes an object of both affection and fear. Lastly, early socialization and habituation efforts may exert profound and lasting influences on the activity of emotional command systems. Whether such ontogenetic influences result in the development of abnormal coping behavior appears to depend on biogenetic influences (e.g., temperament traits) affecting the way the dog processes and responds to environmental adversity. Many dogs are exposed to suboptimal and stressful environments, but only some of them ultimately develop behavior problems. Furthermore, some dogs may exhibit severe problems in the absence of a known history of significant stress and may continue to do so despite improved social interaction and environmen-

tal enhancements, underscoring the important role played by heredity in the etiology of certain behavior problems.

Modulatory and Unifying Effects of Play

The activation of care (contact comfort and affection) circuits and play drive (joy system) produces significant modulatory effects on primitive emotional command systems. Tactile stimulation has been shown to restrain aversive arousal associated with stressful situations (see *Effects of Touch* in Volume 1, Chapter 4). Contact comfort associated with touch exerts an inhibitory influence over both fear and panic (separation distress), apparently by mobilizing a potent oxytocin-mediated antistress response (Uvnäs-Moberg, 1998a; Holst et al., 2002; Lund et al., 2002). In addition, somatosensory stimulation may enhance social familiarity and exert a significant inhibitory effect over aggression (Panksepp, 1998). The usefulness of petting and affectionate praise has been well established in dog training. Play offers many therapeutic benefits for the management of arousal and behavioral output deficiencies and excesses associated with emotional command systems. The eduction of modal play enables trainers to access species-typical motor subroutines that are normally under the exclusive control of specific emotional command systems. Playing fetch appears to access behavior associated with the seeking system (prey drive), whereas tug and roughhousing games may access behaviors associated with the rage system (fight drive) while remaining in the play mode. Under the influence of play, virtually the entire repertoire of motor and expressive actions associated with threat (snarling, growling, and barking) and attack (lunging, biting, and shaking) can be evoked in many well-trained dogs with little risk of a scratch to bare skin. The activation of modal play can help a dog overcome a variety of the fears associated with new places and things, whereas activation of social modal activities (care seeking, following, and begging) can be used to reduce social inhibitions, aversions, and aggression. Play therapy specifically aims to access these various behavioral and emotional systems in order to modify activity associated with them. Combining play therapy and training provides an extremely powerful means for modifying dog behavior and enhancing social trust. Virtually all training and behavior-modification efforts take place with the dog *in drive*, that is, in a phylogenetic mode of activity, whether it be food reward (seeking system), escape/avoidance (fear system), praise and petting (social bonding/panic system), or aggressive play (rage system). Modal play is unique in that it is able to recruit activity from a variety of emotional systems and produce unique variations and modifications through learning (i.e., projects), helping to bring these diverse elements and novel connections into harmony. In doing so, play appears to liberate species-typical behavior patterns from primitive emotional systems, allowing dogs to safely practice skills and engage in novel projects that might not otherwise occur. Play promotes the activation of affects associated with enhanced harmony, balance, and joy (see *Fair Play and the Golden Rule* in Chapter 10).

Play appears to be inhibited by increasing levels of aggression or heightened exploratory or seeking activity, as well as fear and social loss. As play approaches the extremes of evoking actual aggression, fear, or separation distress, it is rapidly inhibited:

> Play may help animals project their behavioral potentials joyously to the very perimeter of their knowledge and social realities, to a point where true emotional states begin to intervene. Thus, in the midst of play, an animal may gradually reach a point where true anger, fear, separation distress, or sexuality is aroused. When the animal encounters one of these emotional states, the playful mood may subside, as the organism begins to process its predicaments and oppositions in more realistic and unidimensional emotional terms. (Panksepp, 1998:283)

Play is most likely to occur in familiar places and between familiar persons and dogs (Mitchell and Thompson, 1990). The balancing effects of play make it useful in the treatment of a variety of behavior disturbances. Play therapy is particularly useful in the management and treatment of behavior problems involving social stress and impulsive behavior. Like play, behaviors associated with drive

appear to be maintained by motivational states immediately produced by behaving in drive. The mere opportunity and *choice* to behave in drive appears sufficient to support the future occurrence of the behavior, and, consequently, drive-related behavior does not depend on reinforcement derived from other activities (e.g., obtaining food or affection), that is, extrinsic or adventitious sources of drive gratification. Behaving in drive is intrinsically reinforcing and self-perpetuating.

Adaptive Coping Styles: Play, Flirt, Forbear, and Nip

During the process of domestication, selection pressures appear to have favored a genotype expressing a configuration of neuropeptides, neurotransmitter, and receptors conducive to a highly adaptable and sociable canine phenotype. These evolutionary changes at the neurobiological level are assumed to exert a profound organizing effect at the social level, shifting behavioral thresholds toward increased tolerance (e.g., elevating fight and flight thresholds) and affiliation (e.g., lowering care-seeking and care-giving thresholds), altering the dog's responsiveness to social signals, perhaps making the human a supernormal stimulus for bonding and forming friendly relations (see *Supernormal Attachment Hypothesis* in Volume 2, Chapter 4). This general hypothesis is supported by neurobiological and behavioral changes exhibited by silver foxes selected for tameness (see *The Silver Fox: A Possible Model of Domestication* in Volume 1, Chapter 1). Tame foxes express a significantly altered hypothalamic-pituitary-adrenal (HPA) system, exhibiting reduced reactivity to social stressors; they also show evidence of increased serotoninergic and catecholaminergic activity conducive to enhanced impulse control and a reduction of defensive behavior.

Under natural circumstances, animals expressing elevated fear and aggression thresholds would be at considerable risk and disadvantage with respect to mobilizing defensive measures against threats; under the protective influence of domesticity, however, such a pattern of reduced fear and aggressive reactivity would be an advantage to a dog, whereas an opposite pattern of heightened flight-fight system (FFS) activity would be highly problematic and incompatible with domestic relations and activities. In response to the unique social stressors experienced by dogs living in close association with people, dogs appear to have evolved novel adaptations enabling them to live in harmony with human companions. The dog's capacity to form social bonds with humans is of such magnitude that it overshadows social attraction toward other dogs, even its mother (see *Maternal Separation and Stress* in Chapter 4). Under contemporary circumstances, this ancient adaptation is a mixed blessing for the average dog left alone all day. Such dogs are at a risk of developing insecure or excessively strong and exclusive social attachments, making them vulnerable to suffer distress at separation. During the dog's early domestication, staying close to its keepers would have been a source of security, with the human keeper taking on the role of benefactor and protector (tend-and-befriend adaptions), allowing human and dog to form close bonds, and allowing the protodog to progressively shed its FFS reactivity and evolve flirt-play and forbear-nip adaptive strategies. In an important sense, when a dog is left alone, it loses its guardian shield of protection and security.

Phylogenesis, Polymorphism, and Coping Styles

Dogs appear to have evolved two relatively independent but overlapping and complementary defensive systems and styles for coping with disappointing, threatening, stressful, or aversive social situations. These hypothetical systems are present in varying degrees in all dogs, depending on heredity and activating experience. The adaptive coping styles (flirt-play and forbear-nip) are largely composed of the self-preservative and self-protective strategies of the young, reflecting a paedomorphic social adaptation. When presented with a threatening social situation, such dogs tend to exhibit an admixture of two general patterns: (1) stable introversion, a variety of attention-seeking, care-seeking, and submissive behaviors (not necessarily authentic), a genuine appetite for and enjoyment of close social

contact and interaction, and a passive "grin and bear it" strategy to aversive stimulation or escape when pushed too far; or (2) stable extraversion, showing a genuine love of rough-and-tumble play and object play, a variety of playful escape and evade tactics, and a "bite the bullet" strategy to aversive stimulation or inhibited nip when pushed too far. The vast majority of dogs appear to combine these various adaptive strategies in varying proportions to form adaptive coping styles with which to manage stressful interaction with human companions. For the sake of simplicity, the term *flirt-and-forbear* system is used to designate this antistress, antifear, and antiaggression system of domestic adaptations.

In addition to fostering a heightened capacity for social affiliation, cooperation, and play, novel physiological mechanisms have evolved to support the flirt-and-forbear and tend-and-befriend styles of human-canine adaptive coping and bonding. Although the exact neurobiological substrates integrating these adaptive coping styles are not known, phylogenetic changes to the oxytocin-opioidergic system, the serotonergic stress-management system, and the dopaminergic reward system appear to be likely focal points of coevolutionary change. In any case, biobehavioral changes conducive to enhanced playfulness, social reward, social cognition, and emotional adjustment appear to have taken place in a process of phylogenetic enculturation, to borrow and extend Hare's term (Hare et al., 2002), whereby humans and dogs have mutually accommodated the other via a unique coevolutionary process (see *Coevolution, Play, Communication, and Aggression*). Over the course of 135,000 years of coevolution (Vilà et al., 1997), humans and dogs appear to have exerted a profound social and emotional transformation upon one another, mutually evolving changes conducive to close affiliation. Many of these changes appear to have taken place in the direction of social, cognitive, and behavioral neoteny; that is, humans and dogs have coevolved in a way that has caused each species to retain more juvenile characteristics into adulthood (see *Paedomorphosis* in Volume 1, Chapter 1), giving rise to our mutual appreciation and capacity for affection and our love of play, among other things. As incredible as the notion may seem, the human-dog capacity for affiliative bonding and play appears to be organized and integrated at the level of mutual modifications of the human and canine genome, a phylogenetic testament to an ancient and perennial bond etched forever into our respective genotypes, as friends might scrawl their initials side by side on an old tree.

Accordingly, humans and dogs appear to have evolved complex and genetically polymorphic adaptations as the result of this evolutionary convergence and phylogenetic enculturation process—changes that should be evident in the matrix of physiological and neurobiological processes from which social cognition, emotion, and adaptive coping styles emerge. This general theory suggests that among dogs there is not a single species-typical nature, but rather an assortment of multiple canine natures that emerge under the influence of polymorphic variations, ontogenetic stressors, and epigenetic organizing influences (see Bittner and Friedman, 2000). Biological adaptations conducive to harmonious human-dog interaction are expressed at the level of an infinitely complex array of biogenetic and neurobiological processes from which functional and structural systems of biobehavioral organization gradually emerge, giving rise to the capacity for cognition, emotional, and the capacity to adapt by means of learning and goal-oriented initiative. Of particular interest from the practical vantage of cynopraxic training and therapy are the neurobiological changes that resulted in the development of the previously discussed canine adaptive coping styles.

Oxytocin-opioidergic Hypothesis

Brown and colleagues (2001) may have discovered a potentially significant link pertaining to the dog's adaptive abilities and capacities for social attachment and bonding in a unique modification of the canine oxytocin-opioidergic system. As discussed in Chapter 4 (under *Maternal Separation and Stress*), oxytocin and endogenous opioids appear to interact in the process of forming social attachments. Opioids also play a major role in

modulating distress and pain. In adult animals, opioids appear to exert an inhibitory effect on central and peripheral oxytocin release. In dogs, however, opioids appear to inhibit central oxytocin release while at the same time stimulating peripheral release—a phenomenon that appears to be unique to dogs. The physiological implications of this finding are not clear, but given the strong correlation between increased peripheral oxytocin activity and social approach, attachment, and antistress effects, this apparently novel adaptation may contribute to the dog's ability to cope physiologically with social stressors unique to living in close association with humans. Oxytocin appears to exert an agonist effect on endogenous opioid activity (Lund et al., 2002), and facilitates exogenous opiate activity by reducing tolerance effects and by attenuating withdrawal symptoms (Sarnyai and Kovacs, 1994). Oxytocin has also been shown to enhance active avoidance learning, perhaps by reducing emotional arousal (Uvnäs-Moberg et al., 2000). Together with arginine vasopressin (AVP) and corticotropin-releasing factor (CRF), oxytocin appears to play a role in the acute integration the stress response, but after repeated release of oxytocin, perhaps in association with endogenous opioids, mediates an antistress and calming effect (e.g., reduces anxiety, decreases blood pressure, and decreases glucocorticoid release) (Uvnäs-Moberg, 1997), whereas AVP and CRF continue to mobilize stress-related physiological changes conducive to increased anxiety, glucocorticoid release, and blood pressure.

Uvnäs-Moberg and colleagues (1997 and 1998a and b) at the Karolinska Institute, Stockholm, have intensively investigated the antistress effects of oxytocin, reporting several lines of compelling evidence in support of the antistress hypothesis. Peripheral oxytocin promotes parasympathetic normalization via enhanced vagus-nerve tone, modulates irritability, decreases sympathetico-adrenal tone, promotes anabolic metabolism, and exerts a calming effect and a host of other effects consistent with an antistress function. For example, oxytocin plays a central role in the regulation of heart rate and coronary flow, cardiovascular effects that are mediated by oxytocin terminals acting on the vagus nerve at the level of nucleus of the solitary tract (Higa et al., 2002) and by means of a direct bradycardial action on the heart itself, among other routes (Petersson, 2002). The central and peripheral effects of oxytocin on canine blood pressure and heart rate are complicated, with oxytocin and AVP appearing to have complementary roles in the regulation of cardiovascular activity (Montastruc et al., 1985). Although the blood-brain barrier shows a low permeability to oxytocin, some passive transport may occur in the case of high peripheral concentrations in association with injections (Ermisch et al., 1985; Uvnäs-Moberg et al., 2000).

Together with cardiovascular benefits, peripheral oxytocin appears to enter the brain to exert a negative-feedback effect on FFS arousal, thereby mediating a calming influence and elevating thresholds associated with irritability and pain (Lund et al., 2002). In addition to antinociceptive effects occurring at the level of the periaqueductal gray, systemic administration of oxytocin has been shown to increase central α_2-adrenoceptor responsiveness at the level of the locus coeruleus (Petersson et al., 1998), the amygdala, and the hypothalamus (Diaz-Cabiale et al., 2000). Although generally excitatory, norepinephrine (NE) acting at α_2-adrenoceptor sites produces a potent inhibitory effect, appearing to play a crucial role in helping dogs to cope adaptively to social stressors by preventing or ameliorating stress-related dysregulation at the level of the prefrontal cortex (Birnbaum et al., 2000).

Oxytocin is hypothesized to play a major role in the expression of somatic feelings of enhanced comfort and safety (well-being) resulting from the occurrence of conditioned and unconditioned rewards (e.g., vocal encouragement, petting, and food) obtained in the process of adaptive control efforts (see *Origin of Reactive versus Adaptive Coping Styles* in Chapter 4). The social benefits of oxytocin appear to be cumulative, developing as the result of repetitive stimulation of oxytocin release. The oxytocinergic benefits of petting and food rewards appear to exert a potent therapeutic effect over stress, fear, and aggression. On the other hand, complementary dopamine reward circuits appear to encode

cerebral teaching signals that optimize adaptive control efforts by means of detecting and coding positive prediction discrepancies (Schultz, 1998), thereby mediating surprise and cortical reward, play, active modal strategies (e.g., exploring, experimenting, and discovering), and feelings of joy and freedom.

Not all dogs respond to petting with a decreased heart rate, but those that do are also responsive to petting as a reward (Fonberg, 1981). Dogs that exhibit an increased heart rate when petted are typically unresponsive to petting as a reward. Manual restraint also appears to exert a significant heart-rate deceleration effect in dogs, perhaps as the result of parasympathetic rebound effects, a cardiac effect that may be amplified by petting. In the case of nervous pointer dogs, restraint-induced deceleration is not appreciably enhanced by petting (Thomas et al., 1972). These findings suggest that petting may offer a valuable diagnostic tool for differentiating dogs exhibiting adaptive versus reactive coping styles. Dogs responding to petting with an increased heart rate may be vulnerable to stress associated with the activation of the FFS and show an increased propensity for emotional reactivity, social avoidance, and defensive behavior, traits consistent with reactive vulnerability, whereas dogs showing a reduced heart rate when petted may exhibit an antistress response consistent with an adaptive coping style, correlating with traits such as friendly approach and attachment, social dependency, playfulness, and calm. Kostarczyk (1991) found that the administration of atropine to dogs results in significant heart-rate acceleration and abolishes petting-related cardiac deceleration, with dogs becoming avoidant of petting and showing increased excitability, tenseness, and aggressiveness—results consistent with the loss of oxytocinergic regulatory influence over parasympathetic functions. Atropine is a potent oxytocin antagonist shown to block oxytocinergic-mediated bradycardia (Mukaddam-Daher et al., 2001). The reactive emotional responses exhibited by dogs medicated with atropine appear to reflect a loss of control over sympathetic arousal, at least in part due to blocking the antistress effects of oxytocin. As previously mentioned, massagelike tactile stimulation appears to mediate an antinociceptive effect via increased levels of oxytocin at the level of the periaqueductal gray (PAG) (Lund et al., 2002) (see *Neural Circuits Mediating Anger and Rage*). This finding underscores the value of posture-facilitated relaxation (PFR) training for helping to attenuate irritability and contact intolerance.

Cyonopraxis, Antistress, and a Tend-and-Befriend System

Cynopraxic training is performed with the goal of reducing interactive conflict and tension arising from antagonistic control interests. Instead of reacting in accordance with the FFS when exposed to social stressors associated with owner limit-setting actions and periodic separations, the dog learns to adjust to stressors under the calming influence of the flirt/play-forbear antistress system. Cynopraxic therapy organizes interactive transactions and emotional exchanges between the owner and the dog with the goal of bringing a flirt-and-forbear antistress system on-line. The compromise and mutual appreciation associated with cynopraxic training promote interactive harmony and friendly interaction akin to what Taylor and colleagues (2000) have referred to as *tend and befriend* adjustments; unfortunately, the authors seem to assume that such a capacity is the special providence of the female nervous system. On the contrary, the potential for adaptive organization in accordance with the tend-and-befriend system is probably the result of an asexual neural plasticity shared by both male and female humans alike, perhaps arising in the course of human-canine coevolution, giving human beings the capacity for affectionate bonding, supportive and comforting interaction, and intensified feelings of well-being as the result of bonding and sharing a home with a dog. According to this hypothesis, both humans and dogs have jointly evolved specialized antistress capacities conducive to close social interaction and affectionate bonding.

Cynopraxis is essentially an expression of the human capacity to tend (provide the dog with an improved quality of life) and befriend (establish and enhance the human-dog bond), a capacity that dogs learn to reciprocate as the result of socialization and training. The natural orientation of the

human being toward the dog is one of tending and befriending, whereas the dog has evolved a heightened capacity for dependent behavior and friendly reciprocity, operating under the influence of an antistress, antifear, and antiaggression system evolved to cope with stressful interaction and conflict associated with close association with humans, viz., a flirt/play-forbear-nip or, more simply, a *flirt-and-forbear* system. Although male dogs appear to exhibit a greater propensity (as a group) for reactive adjustments in association with the activation of the FFS than do females, under the influence of play, reward-based training, and social interaction conducive to the activation of the flirt-forbear system (e.g., human tending and befriending), both male and female dogs show an extraordinary capacity for adaptive coping and adjustment, allowing the natural canine aptitude for reciprocating human tending and befriending behavior to emerge in the form of interactive harmony, mutual appreciation, and a loving and trusting bond.

Olfaction and Emotional Arousal

Olfaction appears to play a major role in the process of emotional learning and memory. The importance of olfactory learning on emotional behavior is suggested by neuroanatomic evidence showing that olfactory projections reach the amygdala more directly than do other sensory inputs. In addition, olfactory stimuli appear to form rapid and lasting conditioned associations with both attractive and aversive emotional states—associative learning that is mediated from an early age by the amygdala (Sullivan and Wilson, 1993). Oddly, though, neonatal rats exposed to odor-shock conditioning prior to postnatal day 10 show a paradoxical approach response toward the odor instead of avoiding it as one might expect. After day 10, rat pups learn to avoid the odor as the result of aversive conditioning, provided that they had not received prior odor-shock conditioning. Most interestingly, however, if the infant rats have been previously exposed to odor-shock conditioning, they continue to show an approach response toward it, even though they are now neurologically able to learn an avoidance response. Paradoxical conditioning resulting in persistent approach behavior toward a conditioned aversive stimulus may help to facilitate infant bonding and attachment under adverse or socially abusive conditions (Sullivan et al., 2000). These findings may help to explain the tendency of dogs to respond to aversive stimulation by emitting avoidance/escape responses and then engaging in attention-seeking and comfort-seeking behavior toward the person delivering the stimulation (Fisher, 1955) (see *Early Trauma and the Development of Behavior Problems* in Volume 2, Chapter 4). The search for safety in human contact and comfort giving appears to be a significant aspect of the bonding and socialization process.

Recalling that oxytocin exerts an antinociceptive effect (see *Oxytocin-opioidergic Hypothesis*), Ågren (1997) found that rats injected with the peptide appeared to secondarily influence the pain thresholds of untreated cagemates. Further study of the phenomena, revealed that when the untreated cagements were rendered anosmic they no longer showed the change in pain sensitivity, suggesting that olfaction may mediate the effect. This finding offers an interesting olfactory hypothesis to test with respect to the increased playfulness exhibited by puppies at weeks 5 and 7 toward female handlers (Scott, 1992a). Finally, olfactory cues might also play a role in the evident gender bias shown by dogs toward human males and females, with dogs seeming to be more friendly (Lore and Eisenberg, 1986) and less defensive and aggressive toward females than males (Wells and Hepper, 1999). These findings may also have practical value, indicating the possibility that an oxytocin-related substance with antistress properties might be secreted on the skin (sebaceous) or in the sweat of animals treated with oxytocin. Conceivably such material, if it exists, could be isolated, concentrated, and tested for antistress effects. Finally, it is interesting to speculate that some potential benefit may be derived from repeated exposure to an aerosol oxytocin mist, perhaps periodically delivered by a spray dispenser controlled by a timer and attached to a crate or kennel to assist dogs

under stress at home or while under hospitalization.

Olfaction, Fear, and Anger

Many dog owners and trainers have reported anecdotally that dogs appear to smell fear, perhaps helping to explain why some dogs react aggressively toward the diffident approach of nervous people (Sommerville and Broom, 1998). A fearful person would undoubtedly present a significantly different scent picture than a relaxed person. The belief that dogs can discriminate emotional states as the result of scent messages emanating from the pores and breath of humans has not been tested; however, it is highly likely that dogs can detect odors associated with highly emotional and stressful states. Detecting odors associated with human anger and fear would be highly advantageous to dogs. The scent aura at times of intense anger or frustration would likely produce a strong and lasting impression, especially if such odors were followed by severe physical punishment. Exposure to the odors associated with anger or fear may sensitize olfactory attentional processes localized in the amygdala—an area that that is strongly activated by the presentation of olfactory stimuli (Hudry et al., 2001) and prominently involved in emotional learning. Seizure-alert dogs may rely on scent-related changes occurring in advance of epileptic seizures, thereby enabling them to anticipate such activity (see *Ability to Detect and Discriminate Human Odors* in Volume 1, Chapter 4). Many dogs appear to react in a highly emotional manner to seizure activity, becoming fearful or aggressive as the result of such events (Strong and Brown, 2000). Edney (1993) found that dogs anticipating seizure activity typically exhibited signs of increased anxiety and restlessness. At such times, these dogs appeared to act strangely and were more difficult to control than usual.

Donovan (1967) has tested the hypothesis that dogs may express their anal glands in order to facilitate escape from threatening restraint. After manually expressing anal sac fluids, he presented the material to various puppies and dogs to sniff. He found that puppies showed no response to the anal fluids, whereas adult dogs "recoiled and appeared apprehensive" (1048) when presented the fluids smeared on plastic gloves:

> Dogs that previously dashed enthusiastically to the opened gate of the exercise pen, turned back as if halted by an electric shock when the gloves were held in the opened doorway. (1048)

The fact that puppies showed little reaction to the odor suggests that the fearful response might have been acquired as the result of learning. As the result of expressing anal fluids consequent to intensely threatening events, dogs may associate such odors with the fear and escape behavior that occurred at such times. When another dog, perhaps under the distress of an attack, subsequently releases the odor, it may evoke a conditioned escape response in the attacker, thereby possibly turning the attacker away and protecting the loser from injury. Similarly, the deposition of anal secretions in feces may exercise a conditioned repellent effect helping to ward off intruders. In summary, according to this hypothesis, anal fluids are not inherently repellent, but may rapidly become so as the result of aversive conditioning. The scent of anal secretions may be highly prepared for association with fear and escape behavior, making biological extracts or synthetic analogues of anal fluids potentially useful for the management of certain aggression problems (see *Threat and Appeasement Displays* in Volume 2, Chapter 8).

Chemosignals, Social Behavior, and the Modulation of Emotional Thresholds

In addition to conditioned social odors, it is reasonable to assume that various chemosignals and pheromones are exchanged between dogs to modulate emotional thresholds (motivational readiness). Social chemosignals may serve to amplify the significance of other social signals present at the time of their expression, as well as promote positive mood states conducive to friendly social interaction. These modulatory effects of olfactory signals on social behavior and mood may help to explain the significance of the canine custom of mutual anogenital presentation and exploration exhibited by most dogs during close

encounters with other dogs, especially unfamiliar ones. Chemosignals and pheromones may offer a valuable means for promoting affiliative interaction by increasing positive affect and mood while elevating aggression thresholds. Reportedly, a dominance pheromone may be contained in the cerumen of dominant dogs—a substance that appears to facilitate submission behavior in subordinates (Pageat, personal communication, 2001; Pageat, 1999). Interestingly, the steroids estratetraenol and antrostadienone have been shown to produce modulatory effects on human affect and mood consistent with a social function (Jacob and McClintock, 2000).

Olfactory Conditioning

Odors are rapidly conditioned and appear to exert pronounced effects over emotional behavior. Although experimental evidence is lacking in dogs, research with human subjects has shown that ambient odors presented during stressful or frustration-inducing experiences exert lasting effects. For example, Kirk-Smith and colleagues (1983) found that odors present while adults worked at a stressful task acquired the capacity to elicit increased anxiety when they were encountered again. Similarly, children exposed to an ambient fragrant scent while working on an insolvable maze task generating emotions of failure and frustration showed increased problem-solving deficits when exposed to the same odor while working on a solvable cognitive problem (Epple and Herz, 1999). The children exposed to the conditioned odor performed less efficiently on the problem than children exposed to another fragrant scent or no scent at all.

Olfactory conditioning for the purpose of reducing aversive emotional arousal in dogs has proven to be useful in a variety of training and behavior-therapy contexts. By pairing a dilute odor with relaxing massage and petting, or other sources of reward, relaxation, and safety, the odor stimulus gradually becomes conditioned to produce similar emotional effects independently of the unconditioned stimulus used. The close ontogenetic relationship between olfaction and tactile sensory development may prepare odors for rapid association with taction-elicited emotional states (see *Social Comfort Seeking and Distress* in Volume 2, Chapter 4). The pairing of an olfactory stimulus with taction-induced relaxation establishes a conditioned association between the odorant and relaxation so that the odor alone can either facilitate or independently evoke the relaxation response (see *Posture-facilitated Relaxation Training* in Chapter 7).

Practitioners of aromatherapy attribute special psychological and medical benefits to fragrant oils (Tisserand, 1977), but few of these claims are supported by scientific studies, especially in the case of animals (Wynn and Kirk-Smith, 1998). However, several studies in humans do indicate that aromatherapy may augment a modest and transient reduction in anxiety when combined with massage (Cooke and Ernst, 2000). Traditionally, many fragrant oils have been reputed to have relaxing and calming attributes; however, the beneficial effects of odors on mood and emotions probably depend more on conditioning than an inherent property of the scent. Some odors, though, do appear to exert benefits on mood, aversive states, and stress-related changes independently of conditioning (Shibata et al., 1990 and 1991). For example, the odor of lemon has been shown to produce an antidepressant effect in rats (Komori et al., 1995), and the odor of orange has been shown to reduce anxiety while promoting a more calm and positive mood in people receiving dental treatment (Lehrner et al., 2000). Lavender, chamomile, and vanillin have also been shown to exert central effects consistent with improved mood and anxiety reduction (see *Fear of Loud Noises and Household Sounds* in Chapter 3).

Although a particular fragrant oil may be pleasing to a human nose, it may not be equally attractive to a dog. Whatever odor is selected should not be aversive to the dog or presented at a concentration too strong for the dog's sensitive nose. The odorant should be delicate and faint to the human nose and, ideally, evoke interested sniffing by the dog. Odors that cause the dog to turn its nose away should not be used. Many dogs appear to be actively attracted to sandalwood, which

has a soft mellow quality that provides an adequate odorant for most dogs when diluted 1:30–50 in a carrier vegetable oil. Citrus odors (e.g., lemon or orange) and lavender may have some additional advantages in the treatment of separation distress, phobias, and various anxiety-related problems.

In addition to pairing an odor with taction-induced relaxation, other scents can be paired with the presentation of food rewards and other sources of attractive stimulation. A highly effective method involves putting 1 or 2 drops of a fragrant oil or extract inside a squeaker used as conditioned reinforcer. With each squeak, the odor is dispensed into the air, thus pairing the odorant stimulus with success and reward. This same odor can be presented just before feeding the dog, as well. A play odor can be developed by putting a scent on play objects or presented in advance of getting the dog's leash to go for a walk. An olfactory safety signal can be paired with the opponent relief and relaxation associated with the discontinuation of an aversive state [e.g., an odor can be delivered under the door just before concluding a time-out (TO) period]. The idea is to pair odors with activities that access specific behavioral and emotional systems having value for specific behavior-modification objectives. Conditioned olfactory relaxation, reward, and safety stimuli provide useful means to modulate emotional states associated with undesirable behavior operating under the influence of aversive arousal (e.g., frustration, fear, anger, or irritability). Finally, using scents creatively, such as training the dog to find scented play objects, provides valuable environmental enrichment and stimulation to the dog.

NEUROBIOLOGICAL REGULATION OF AGGRESSION

Stress-related Potentiation of the Flight-Fight System

Conditioned threats and stressors are processed by a complex network of reciprocal cortical and subcortical pathways, projecting to and from the amygdala, the hippocampus, the hypothalamus, the PAG, and several other areas (Panksepp, 1998). The medial prefrontal cortex appears to perform a goal-oriented appraisal function based on prediction-control expectancies and calibrated establishing operations, whereby autonomic arousal is continually matched to expected adjustment needs. In the case of aversive events, behavioral adjustments that produce better-than-expected outcomes result in de-arousal and a reduction of autonomic activation (relief and reward), whereas worse-than-expected outcomes result in increased arousal, alertness, readiness, and agitation. In the case of unpredicted or uncontrollable aversive events, subcortical pathways may rapidly mobilize neurobiological changes conducive to emergency adjustments, including the instigation of the FFS, with the release of CRF and the activation of the HPA system (see *Stress and Flight or Fight Reactions* in Chapter 4). The amygdala appears to play a central role in the orchestration of the FFS, operating in coordination with the prefrontal cortex, where executive organizing functions and activities are momentarily overshadowed by a priority to attend to immediate sensory information and to adjust rapidly to the threat. As a result, behavior output shifts from an adaptive interface, based on prediction-control expectancies and establishing operations, to a reactive interface based on species typical modal escape-attack behaviors.

Instrumental control over aversive events is reflected at the level of autonomic arousal, with blood pressure increasing in response to uncontrolled aversive events while remaining steady during signaled avoidance (Gaebelein et al., 1977). In addition, dogs that are unable to escape aversive stimulation show a significantly stronger adrenocortical stress response than dogs that are able to escape (Dess et al., 1983) or when instrumental control over an aversive event is lost (Houser and Paré, 1974) (see *Fear and Peripheral Endocrine Arousal Systems* in Chapter 3). Cook (2002) has studied the stress response of sheep when exposed to the threat of a barking dog while under an escapable condition and under a nonescapable condition. Sheep show a two-phase change in CRF concentrations in the amygdala. The first phase involves a sharp CRF spike attributed to central arousal effects, which is followed by a

slower and smaller-magnitude spike of CRF activity that closely shadows blood cortisol concentrations. Whereas the injection of a glucocorticoid antagonist just prior to stimulation had no effect on the first sharp spike of CRF, it abolished the second smaller spike, a finding that supports the hypothesis that cortisol may exert an acute activating effect on the central amygdala. The researcher found that repeated and inescapable exposure to a barking dog produced a pronounced sensitizing effect on amygdala-CRF activity when the sheep were subsequently exposed to a novel aversive event (1 second of shock).

In the case of sheep belonging to the nonescape group, a very pronounced and sustained activation of second-phase CRF activity occurred, indicating a potentiated responsiveness of the CRF neurons in the amygdala. As a result of repeated exposure to the threatening dog, the nonescape group showed signs of adapting with decreasing amounts of first-spike CRF activity, but showed a steady increase of blood cortisol levels over the course of the experiment. This evidence of habituation with regard to the first spike may indicate a modulatory prefrontal influence, whereas the increasing cortisol levels and evident sensitization of amygdala-CRF circuits may indicate a maladaptive elaboration akin to what Gannt has call schizokinesis (see *Gantt: Schizokinesis, Autokinesis, and Effect of Person* in Volume 1, Chapter 9). The sheep belonging to the escape group also showed signs of adapting in response to the acute phase of stress, and, unlike the nonescape group, the escape group showed a steady decrease of blood cortisol activity after repeated exposures to the barking dog. These findings support the hypothesis that behavioral stress associated with the loss of control over aversive events exerts a lasting potentiating effect on subsequent exposures to stressors (anticipatory anxiety), perhaps via sensitized amygdala-CRF circuits and schizokinetic elaborations. As a result, uncontrollable stressors may gradually cause dogs to become sensitized (irritable and intolerant) to aversive stimuli, perhaps causing them to respond to innocuous social threats with exaggerated emotional and reactive output that persistently mismatches executive prediction-control expectancies.

Neural Circuits Mediating Anger and Rage

The amygdala plays a prominent role in the rapid processing of ambiguous and potentially dangerous stimuli (Adolphs, 2001). Modulatory signals leaving the amygdala converge on both cortical and subcortical destinations, with amygdaloid pathways both facilitating and suppressing defensive rage behavior (Siegel et al., 1997). The pathways producing anger and rage appear to originate in the medial amygdala, whereas suppressive influences originating in the central amygdala project directly to the midbrain PAG, where inhibitory connections are formed with opioidergic receptors. The PAG mediates a variety of changes conducive to affective attack, including autonomic changes (increased respiration and heart rate), increased alertness and excitability, and facial expressions associated with threat and biting actions (Panksepp, 1998). Anger-rage pathways originating in the medial amygdala reach the medial hypothalamus via the bed nucleus of the stria terminalis (BNST). From the medial hypothalamus, the anger-rage signal is relayed to the PAG. The neuropeptide substance P appears to play a prominent role in the expression of anger and rage. Psychological stress is believed to stimulate the release of substance P in the amygdala (Kramer et al., 1998). In cats, a substance P pathway between the medial amygdala and the medial hypothalamus promotes defensive rage via interaction with excitatory glutamate neurons projecting to the PAG (Siegel et al., 1997; Gregg and Siegel, 2000)—behavior that is blocked by neurokinin 1 (NK-1) antagonists. The NK-1 receptor mediates central substance P activity and is found throughout the brain, with concentrations located within the limbic system and hypothalamus. Knockout mice lacking the NK-1 receptor show a significant reduction of territorial aggression and other measures associated with acute stress and injury (De Felipe et al., 1998). Currently, a promising orally assimilable NK-1-receptor antagonist is under development for the treatment of depression

(Kramer et al., 1998). The substance, MK-869, produces potent antidepressant effects comparable to paroxetine but with fewer side effects. Given the involvement of substance P in the mediation of aversive arousal and aggression, MK-869 may eventually prove of value in the treatment of canine aggression problems, but at the moment its clinical efficacy and safety as an antiaggression agent in dogs is unknown. Interestingly, antidepressants have been shown to downregulate the biosynthesis of substance P in rats, suggesting the possibility that the apparent beneficial effect of such medications may be due, in part, to alterations of the neurokinin system (Kramer et al., 1998).

Threatening stimuli activate the sympathetic branch of the autonomic nervous system (ANS) via various direct and indirect pathways between the amygdala, lateral hypothalamus, locus coeruleus, and sympathetic preganglionic neurons terminating in various parts of the body, with the prefrontal cortex playing a prominent modulatory role at virtually every level of central organization (see *Stress and Flight or Fight Reactions* in Chapter 4). The resulting widespread sympathetic arousal prepares the organism for emergency flight or fight action. As the result of sympathetic arousal, epinephrine (adrenaline) and NE are rapidly released into the bloodstream by the adrenal medulla (see *Hypothalamus* in Volume 1, Chapter 3). Epinephrine and NE have widespread energizing effects on the body, including pronounced effects on cardiovascular activity. Although epinephrine cannot cross the blood-brain barrier, some researchers have reported that epinephrine appears to play a significant role in the consolidation of aversive memories (see *Neural Stress Management System and Fear Learning* in Volume 1, Chapter 3). The memory-enhancing properties of epinephrine may be mediated indirectly by way of afferent vagal nerve transmissions. Le Doux (1996) has suggested that vagal afferent signals triggered by peripheral epinephrine might help to explain how epinephrine facilitates the formation of memories about aversive events. The vagus nerve at the nucleus of the solitary tract forms reciprocal connections with the hypothalamus and the locus coeruleus. The nucleus of the solitary tract performs a host of integrative functions in the process of modulating autonomic arousal via direct reflexive feedback effects on various organ systems, as well as a diffuse network of reciprocal feedback links with the lateral hypothalamus, the central amygdala, and the BNST, among other sites. The locus coeruleus is composed of NE-producing neurons that form widespread interconnections throughout the brain, including the amygdala and the hippocampus. These areas are believed to be closely involved in the consolidation of aversive memories, leading to Le Doux's hypothesis that epinephrine via vagal enervation might play a significant role in their formation. In addition to mediating the formation of aversive memories, NE has been shown to influence the expression and regulation of affective aggression (see *Monoamines and the Control of Aggression* in Volume 1, Chapter 3) (Eichelman, 1987). Defensive behavior in cats is associated with the activation of NE-producing neurons, an effect that appears to help prepare the animal to respond to threatening situations (Levine et al., 1990). Anger-induced changes in heart rate and blood pressure may activate aggression-mediating circuits (NE and otherwise) via a similar afferent vagal feedback mechanism postulated to facilitate aversive memories.

Biogenetic influences strongly affect sympathetic and parasympathetic nervous activity. These antagonistic arousing and de-arousing autonomic influences differentially affect a wide variety of behavioral thresholds, with sympathetic-dominant dogs tending to be more reactive to provocative stimulation than parasympathetic-dominant counterparts (see *Genetic Predisposition and Temperament* in Volume 1, Chapter 5). Sympathetic-dominant dogs can often be differentiated from parasympathetic-dominant ones by the degree of skeletal muscle tonus that they exhibit. The medulla mediates normal resting muscular tonus and produces tonus changes in response to sympathetic arousal. Increased muscle tonus may reflect an increased standing readiness for emergency action resulting from neurobiological predisposition and learning associated with aversive arousal (e.g., fear and anger). Dogs that exhibit the rigid muscular tonus consistent with sympathetic-dominance are often the most responsive to the muscle-

relaxing effects of PFR. Alterations in blood pressure are a sensitive indicator of autonomic tone in response to environmental and social stressors (Wilhelmj et al., 1953; Kallet et al., 1997). The expression of sympathetic and parasympathetic typologies appears to be strongly influenced by gender. Significant gender-related differences in blood pressure have been reported in dogs (N = male, 67; female, 80) and in female dogs (N = 80) (Van Liere et al., 1949), perhaps reflecting underlying gender-related autonomic differences modulating emotional responsiveness to environmental stimulation. According to the gender hypothesis, males and females may be biologically different on the level of autonomic responsiveness, with males tending toward sympathetic dominance and females being more inclined toward parasympathetic dominance. The gender hypothesis is consistent with the findings of Hart and Hart (1985), indicating that male dogs are rated to be more prone to exhibit reactive behaviors (sympathetic dominance), whereas females tend to be more affectionate and trainable (parasympathetic dominance).

Amygdala-mediated emotional interpretation of social and environmental stimulation appears to be coordinated with the impulse-control functions of the prefrontal cortex and contextualizing influences emanating from the hippocampus. Sudden change or situations requiring rapid assessment of threat may result in inappropriate aggressive responses in animals possessing a strong agonistic tone. Compromised attention resulting in startle may also precede a rapid transition from a state of vulnerability to defensive aggression. A common situation involving aggressive arousal in dogs occurs when they are disturbed while asleep or in a hypnagogic state just preceding the induction of sleep. Such dogs may misinterpret the owner's actions, and without the benefit of fully alert and functional executive attention and impulse control, they may become enraged and bite.

Autonomic Arousal, Heart Rate, and Aggression

Aggressive dogs frequently exhibit a collection of exaggerated autonomic responses to social threats, including increased behavioral excitability, panic, and fear. Canine domestic aggression (CDA) is usually expressed under the influence of significant autonomic arousal—catastrophic arousal that often appears to be out of proportion to the eliciting situation (see *Loss of Safety, Depression, Panic, and Aggression* in Chapter 7). These autonomic changes, similar to symptoms of panic, appear to take control of the dog. In significant ways, dogs that attack their owners despite the presence of strong affectionate and familiar ties resemble human perpetrators of domestic violence. In fact, panic-evoked aggression may represent a viable animal model of domestic violence. Studies investigating perpetrators of domestic violence indicate that such individuals experience intense autonomic arousal and various symptoms of panic (e.g., palpitations, fear, increased respiration, feelings of losing control, and tremors) at the time of attacks. Among dogs, enhanced control over aversive events has a potent moderating event over blood pressure, heart rate, and glucocorticoid release, whereas the loss of control exerts a pronounced disinhibitory effect on physiological markers of sympathetic autonomic arousal (Houser and Paré, 1974). Perpetrators of domestic violence appear to cope differently with autonomic arousal than do nonviolent counterparts, exhibiting neural differences in the way heart rate is regulated (Umhau et al., 2002). In addition to exhibiting differences in the way their heart rate is regulated, perpetrators exhibit a pronounced autonomic response to sodium lactate infusions (George et al., 2000). The potentiating effects of sodium lactate on the autonomic arousal and panic-rage behavior exhibited by perpetrators of domestic violence suggest the possibility that canine aggressors might show a similar pattern of autonomic and behavioral responsiveness to a panicogenic agent. Monitoring and comparing the vagal tone of nonaggressors and aggressors in response to neutral, stressful, and relaxing stimulation might yield potentially valuable clues concerning the etiology of panic-evoked aggression.

People exhibiting antisocial and aggressive behavior often exhibit significantly reduced autonomic responsiveness to social stressors, as measured by heart rate and skin conductance. Adult criminals and antisocial adoles-

cents tend to exhibit lower resting heart rates, perhaps reflecting a reduced responsiveness to fear-provoking stimulation or a lack of normal sensitivity to hedonic or nociceptive stimuli (anhedonia), a common sign of posttraumatic stress disorder (PTSD) (see *Posttraumatic Stress Disorder* in Volume 1, Chapter 9). The significance of fearlessness is based on an assumption that many aggressive actions depend on a reduced level of fear and anxiety. Fear and anxiety may directly inhibit aggressive behavior or facilitate its inhibition via punishment and other conditioning efforts. The presence of autonomic hyporesponsive suggests that antisocial and aggressive behaviors are driven by an aversive physiological state associated with low arousal. According to the stimulation-seeking theory, antisocial behavior is emitted to bring autonomic arousal up to normal levels; that is, the behavior serves a homeostatic function. Fearlessness and stimulation seeking appear to interact in the case of antisocial and violent individuals (Raine, 2002) and dogs: fearlessness and stimulation seeking are the defining characteristics of c-type dogs. Another indicator linking autonomic hyporesponsiveness with aggressive behavior is the presence of low cortisol levels (see *Stress, Low Cortisol, and Aggression*). This combined evidence strongly suggests the need for basic research dedicated to evaluating and comparing the autonomic activity and reactivity of canine aggressors and nonaggressors.

Aggressive arousal is associated with sympathetic activation and release of epinephrine by the adrenal medulla. One effect of epinephrine is to accelerate heart rate, a change that may be interpreted by the brain as signifying danger and setting into action a variety of neurobiological changes that prepare dogs to take offensive (anger) or defensive (fear) action. Social and contextual stimuli associated with aggressive arousal may result in conditioned cardiovascular changes that prepare dogs for offensive or defensive action via the FFS. In addition, certain conditioned *signature* cardiac changes occurring in association with aggressive episodes in the past may trigger aggressive preparatory responses, motivationally increasing a dog's readiness to threaten or attack. These conditioned changes in heart rate, blood pressure, and coronary flow may mediate the activation of metered norepinergic activity, resulting in varying degrees of aggressive arousal. Heart-rate patterns appear to differ according to an animal's social rank. Among squirrel monkeys (Candland et al., 1970) and chickens (Candland et al., 1969), the highest-ranking and lowest-ranking individuals exhibit the highest heart rates, whereas middle-ranking animals show the lowest heart rates. The influence of social status on heart rate may reflect divergent motivational effects of competition on sympathetic tone, increasing the propensity of dominant dogs to fight (anger-induced acceleration) and subordinates to flee (fear-induced acceleration). Differences in heart rate have been shown to provide valuable markers with respect to the identification of emotional traits and temperament dimensions exhibited by dogs (Cattell and Korth, 1973), suggesting that a strong biogenetic component may affect arousal threshold and heart-rate changes. Cardiovascular differences associated with anger and fear may provide useful diagnostic indicators for differentiating offensive and defensive aggression, as well as help to identify evocative conditioned social and contextual stimuli associated with its expression.

The heart rates of dogs exposed to anger-inducing arousal undergo significant change indicating pronounced autonomic arousal. Verrier and colleagues (1987) found that anger evoked in association with food protection produces pronounced effects on heart rate, blood pressure, and coronary flow in dogs. On average, during aggressive episodes, heart rate increased from 112 ± 6 to 210 ± 15 beats/minute, arterial blood pressure rose from 95 ± 4 to 142 ± 5 mm Hg, and coronary blood flow increased from 31 ± 5 to 72 ± 9 ml/minute). These values returned to baseline levels after 2 to 4 minutes, suggesting that dogs do not immediately de-arouse following aggressive episodes involving anger. The time course is consistent with Denny's (1976) relaxation phase following the determination of aversive stimulation (see *Safety Signal Hypothesis* in Volume 1, Chapter 8). The extent to which canine aggressors differ autonomically from nonaggressors in the way that they respond to anger-inducing stimulation is not known; however, it is known that stressful avoidance conditioning exerts an

unexpected divergence between heart rate and blood pressure. Anderson and Brady (1971) found that dogs exhibit a significant and stable reduction in heart rate while at the same time showing an increase in blood pressure during a 1-hour waiting period immediately preceding a 2-hour period of stressful shock-avoidance training. The divergence between heart rate and blood pressure steadily increased over the course of the 1-hour waiting period, with heart rates becoming lowest and blood pressure becoming highest just before the onset of shock-avoidance training.

Other studies evaluating the effects of auditory orientation and startle on heart rate have generally found that novel stimuli appear to have a decelerating effect on heart rate, whereas startle generates a rapid acceleration followed by vagal braking and deceleration (Graham and Clifton, 1966). Some human evidence suggests that many antisocial and aggressive individuals are affected by an attentional deficit that impedes their ability to orient toward neutral stimuli and to respond appropriately to startling stimuli in anticipation of aversive events (Raine, 2002). Whether auditory orientation and responsiveness to startle significantly differ in the case of canine aggressors and nonaggressors is not known, but given the findings from studies involving human antisocial and violent behavior, the possibility of such differences related to autonomic arousal and attentional behavior should be seriously investigated.

These sorts of attentional and learning deficits are consistent with a dysregulation of prepulse inhibition (PPI), a sensorimotor gating function that enables dogs to cope effectively with startling events and to sort out their significance (see *Prediction and Control Expectancies* in Chapter 1). Many studies have linked impairment of PPI function with several major psychiatric disorders (Braff et al., 2001). PPI tests are easy to perform, and the results appear to correlate with adaptive cognitive processing. Together with comparisons between standing heart rate and heart rates during petting or massage and heart rates occurring immediately after such stimulation (see *Adaptive Social Coping Styles: Play, Flirt, Forbear, and Nip*), PPI may provide a complementary measure for assessing a dog's relative fitness with regard to cognitive and emotional tone, degree of autonomic reactivity, and vulnerability to stress. For example, a flat or increasing heart rate in response to petting and massage, together with a reduced PPI response, may indicate the presence of a stressful coping style, whereas a decreased heart rate, together with a robust PPI result, may be indicative of a more adaptive coping style and a functional antistress response. Interestingly, oxytocin has been shown to normalize drug-induced dysregulation of PPI (Feifel and Reza, 1999).

Vincent and Leahy (1997) have demonstrated a close relationship between reduced heart-rate variability in response to environmental and social stimulation and a calm/nonstress-prone temperament type in dogs. They found that dogs showing an excitable/stress-prone temperament exhibited a more sharply reactive and variable cardiac response when exposed to environmental and social stimuli. However, the determination of heart rate may not be particularly meaningful and useful as a marker with respect to aggressive behavior. As previously discussed, low heart rates may occur concurrently with divergent high blood-pressure measures resulting from stressful aversive learning (Anderson and Brady, 1971). Perhaps, at least in some cases, the acceleratory change in heart rate occurring in response to petting may reflect a touch-mediated reduction of blood pressure and an autonomic shift resulting in disinhibition. The propensity of some dominance aggressors to attack while being petted or when they are approached in situations that are routinely associated with affectionate contact or comfort may be related to a stress-related dysregulation of central oxytocin or AVP activity (Engelmann et al., 1999). Peripheral and central oxytocin and AVP perform complex regulatory cardiovascular functions influencing heart rate and blood pressure (Montastruc et al., 1985). A divergent low heart rate and high blood pressure may be context sensitive, emerging during specific social interactions and situations associated with aggressive reactivity. A stress-related divergence between heart rate and blood pressure may offer a viable diagnostic marker, a possibility that warrants future investigation. Given the potential importance of cardiovascular function as a diagnostic indicator, such data

should be routinely collected and analyzed, especially in the case of impulsive CDA directed against family members.

Stress, Low Cortisol, and Aggression

Various other physiological and behavioral influences associated with stress may strongly affect aggression thresholds. For example, hungry dogs may be more aggressively reactive to interference when they are eating. A large array of potential stressors—including loud noises associated with household construction activities, thermal changes, lack of exercise and social contact, inadequate play, and excessive punishment occurring on a relatively unpredictable and uncontrollable basis—may lower aggression threshold. Such environmental and interactive influences may further destabilize predisposed dogs to aggressive behavior, whereas more stable environments and interaction conducive to harmonious interaction may produce a compensating or protective effect against the development of aggression problems. The reliance on excessive punishment, especially physical punishment, may produce particularly damaging effects via stress-related changes. Significant biobehavioral stress appears to accrue in animals in association with repeated exposure to social defeat and inability to fully avoid contact with the dominant victor (Blanchard et al., 2001)—a state of allostatic load that may play an important role in the etiology of some cases of CDA involving a history of excessive punishment. Chronic social stress appears to produce global neurobiological changes in major neurotransmitter and neuropeptide systems, as well as mediating stress-related bodily changes via sympathetic arousal and disturbances of the HPA system.

Stress is frequently cited as playing a major role in the etiology of intrafamilial aggression and other behavior problems, but little in the way of significant data has been reported in support of a causal relationship between stress and aggression in dogs. A potentially useful focus for future research involves collecting and profiling the adrenal output of aggressive dogs. One might assume that aggressive dogs with HPA-system disturbances associated with stress would be inclined to exhibit elevated plasma glucocorticoid levels. However, animal studies involving a variety of species, including wolves (McLeod et al., 1995), olive baboons (Sapolsky and Ray, 1989), guinea pigs (Haemisch, 1990), and squirrel monkeys (Manoque et al., 1975), have shown that cortisol levels are typically lower in more aggressive and dominant animals and higher in more submissive and subordinate ones. Rats that have been isolated for long periods (13 weeks) show significant changes in monoamine activity as well as lowered plasma cortisol levels, despite an increase in adrenocorticotropic hormone (ACTH) secretion (Miachon et al., 1993). Social isolation is associated with increased aggressiveness. Recently, Hennessy and colleagues (2001) found that low cortisol levels were a better predictor of problem behavior in puppies adopted from an animal shelter than were high cortisol levels.

A similar association between low cortisol levels and aggression has been reported in children (McBurnett et al., 2000; Pajer et al., 2001). Kagan and colleagues (1987) found a striking difference in cortisol levels correlating with behavioral inhibition in young children (5 1/2 years). Children described as inhibited showed consistently higher levels of cortisol than did uninhibited children. In human adults, high cortisol levels are closely associated with depression (Krishnan et al., 1988), perhaps reflecting a trajectory of HPA-axis dysregulation originating in childhood behavioral inhibition. At the other extreme, low cortisol output has also been reported in association with violent criminal offenders (Virkkunnen, 1985) and with people diagnosed with post-traumatic stress disorder (Yehuda et al., 1990). Other research has found that children exhibiting conduct and oppositional disorders show elevated levels of dehydroepiandrosterone sulfate (DHEA-S) and ACTH without a corresponding increase in cortisol (Dmitrieva et al., 2001). Increased DHEA-S and low cortisol levels have been reported in the case study of a 13-year-old boy exhibiting refractory problems associated with high levels of anxiety, anger, and aggression (Herzog et al., 2001). Treatment aimed at reducing DHEA-S levels (ketoconazole) resulted in marked improvement in both anxiety and aggression symptoms.

Stress, Serotonin, and Aggression

Although the mechanism responsible for the increase in oppositional behavior and aggression in association with low cortisol levels is unknown, the dysregulation of negative-feedback control over CRF and ACTH production may be involved. Chronically low cortisol levels may dysregulate hypothalamic CRF output, possibly causing central stress-related changes, including the inhibition of serotonin (5-hydroxytryptamine or 5-HT) production by the dorsal raphe bodies (Kirby et al., 2000) (see *Startle and Fear Circuits* in Chapter 3). Another influence localized at the level of the dorsal raphe bodies is the facilitatory effect of peripheral glucocorticoids on the efficiency of tryptophan-hydroxylase activity, the rate-limiting factor involved in the production of 5-HT (Azmitia and McEwen, 1974). Under the influence of low glucocorticoid levels, both 5-HT synthesis and its modulatory effects are impeded. Research involving wild house mice provides some intriguing potential clues suggesting a genetic influence mediating the association between low glucocorticoid levels and aggression. Korte and colleagues (1996) studied two groups of mice selected for high-offensive (short-attack latency) and low-offensive (long-attack latency) aggression. High-offensive aggressors exhibited significantly lower levels of corticosterone than did low-offensive aggressors. In addition, they found that high-offensive aggressors exhibited increased postsynaptic 5-HT_{1A}-receptor expression in the frontal cortex and hippocampus—an effect that the authors believe is secondary to lower-circulating corticosterone in the more aggressive mice.

There appears to be significant positive correlations between enhanced 5-HT activity and increased glucocorticoid activity. Supplemental 5-hydroxytryptophan (5-HTP), the immediate biochemical precursor of serotonin, appears to elevate glucocorticoid levels in rats (corticosterone) (Fuller, 1981). In addition, the selective serotonin-reuptake inhibitor (SSRI) fluoxetine produces a significant increase in plasma corticosterone via hypothalamic serotonergic pathways, an effect that is synergistically enhanced when rats are treated with both 5-HTP and fluoxetine (Fuller et al., 1996). The apparent close relationship between low glucocorticoid levels and reduced 5-HT activity suggests that cortisol levels might be diagnostically useful for teasing out subtypes of CDA and perhaps helping to determine appropriate treatment protocols. The role of low cortisol in the etiology and treatment of canine aggression problems is an exciting area that warrants future research.

Serotonin and Aggression

A great deal of animal research implicates the serotonergic system in the control of anxiety and aggression (Olivier et al., 1991). Evidence supporting the modulatory role of 5-HT over anxiety and aggression has been obtained in animals selected for reduced aggression and tameness. Wild Norway rats that had been selected for reduced aggressiveness toward humans exhibit significant alterations involving 5-HT activity. The tame rats exhibit significantly higher levels of 5-HT and 5-hydroxyindoleacetic acid (5-HIAA) in the hypothalamus, as well as a 25% increase in tryptophan-hydroxylase activity in comparison to fearfully reactive and aggressive rats (Popova et al., 1990). The behavioral reactivity of genetically tame and aggressive rats was shown to differ significantly in response to stressful handling and aversive stimulation (Nikulina et al., 1992). When pushed with a gloved hand, aggressive rats frequently attacked the glove, whereas tame rats showed no defensive reaction. When exposed to shock, tame rats launched fewer attacks toward one another than did aggressive counterparts. Predatory attacks directed toward mice were not differentiated between tame and aggressive rats: both groups killed mice within 1 to 3 minutes. Selection for tameness in silver foxes has resulted in similar modifications of the serotonergic system (Popova et al., 1991). Tame foxes show increased 5-HT levels in the midbrain and hypothalamus and higher levels of 5-HIAA in the midbrain, hypothalamus, and hippocampus. Tame foxes also exhibit a significant increase in tryptophan-hydroxylase activity in comparison to captive and aggressive foxes. Tame foxes produce 34% more tryptophan hydroxylase than do aggressive counterparts.

Dogs exhibiting impulsive CDA have been found to exhibit evidence of reduced 5-HT activity (Reisner et al., 1996). The cerebrospinal fluid (CSF) of aggressive dogs contains lower levels of 5-HIAA than that of nonaggressive controls (aggressive dogs, 202.0 pmol/ml, versus nonaggressive controls, 298.0 pmol/ml). 5-HIAA is a product produced by the breakdown of serotonin, with decreased CSF levels indicating reduced serotonin activity. A further reduction in CSF 5-HIAA levels was found in dogs that did not give a warning before biting (aggressive dogs not giving a warning, 196.0 pmol/ml, versus dogs that gave a warning, 244.0 pmol/ml). Low levels of CSF 5-HIAA have also been repeatedly found in people prone to exhibit impulsive aggression and violence. Mehlman and colleagues (1994) found that the severity of aggression exhibited by rhesus macaques was inversely correlated with CSF 5-HIAA levels, with monkeys having low levels of CSF 5-HIAA being more likely to exhibit severe aggression and other signs of decreased impulse control. Similar findings have been reported in the case of vervet monkeys in which decreased 5-HT levels are associated with increased irritability and aggression, irrespective of the monkey's status (McGuire and Raleigh, 1987).

Low levels of CSF 5-HIAA suggest the presence of some degree of dysfunction in the serotonergic system, perhaps involving the stress-related depletion of 5-HT, a chronic failure of affected dogs to produce adequate amounts of it, or other influences reducing its use and metabolism in the brain. In addition to serving a negative-feedback function restraining CRF output, circulating glucocorticoids appear to prime the impulse-controlling effects of 5-HT over cortical and thalamic sensory inputs via GABAergic (gamma-aminobutyric acid) interneurons (Stutzmann et al., 1998) (see *Startle and Fear Circuits* in Chapter 3). Hypothetically, in dogs where low cortisol levels present together with reduced 5-HT activity, one would expect to find an increased propensity to show impulsive aggression and other signs of emotional disturbance. Much of the current research seems to support the idea that 5-HT plays a significant role in the modulation of aversive arousal via GABAergic interneurons at the level of the amygdala—the emotional interpretive center of the anger-rage circuit:

> Decreased serotonergic functioning might result in deficient GABAergic modulation of excitatory sensory efferents, perhaps allowing innocuous sensory signals to be processed through the LA [lateral amygdala] as emotionally stimulating events. Overall, the net effect of 5-HT acting through GABAergic mechanisms in the LA appears to be inhibitory and may therefore serve as a modulator of affective sensory processing. (Stutzmann et al., 1998:3-4)

A variety of 5-HT-receptor subtypes have been identified, with at least 15 different ones currently known (Roth et al., 2000). The HT_{1B} receptor appears to mediate an inhibitory effect over aggression, whereas the 5-HT_{1A} receptor appears to mediate an antianxiety effect, at least in the case of mice and rats. The expression of these serotonergic receptors is dependent on a transcriptional factor, Pet-1 ETS, which is expressed in the embryo just before the first 5-HT neurons appear in the hindbrain. Mice lacking the ability to express Pet-1 do not develop normal 5-HT neurons. Interestingly, though, despite the absence of an effective serotonergic system, Pet-1 null mice show a surprising lack of abnormal structural or behavioral effects, other than becoming more aggressive and anxious as adults. Pet-1 nulls not only attacked more often than controls, they delivered significantly more bite wounds, suggesting a loss of bite inhibition. Consistent with these findings, Reisner and colleagues (1996) reported that, among dogs diagnosed with dominance aggression, those dogs delivering hard and injurious bites tended to have lower levels of CSF 5-HIAA and CSF homovanillic acid (HVA), a dopamine metabolite. Although 5-HT neurons generally exert an inhibitory influence, 5-HT_2 neurons appear to be an exception to this rule. For example, 5-HT_2-receptor agonists appear to facilitate the expression of defensive rage in cats (see Gregg and Siegel, 2001). Interestingly, in this regard, Sugrue (1983) has noted that one of the effects of antidepressants is gradually to downregulate the 5-HT_2 receptor. Recent neuroimaging studies of nonaggressive and aggressive dogs performed by Peremans and colleagues appear to support the hypothesis

that impulsive CDA may be linked to an aberrant upregulation of the 5-HT_{2A} receptor in the frontal cortex (see *Stress, 5-HT_{2A} Receptor Upregulation, and Aggression* in Chapter 10).

Serotonin and Dominance

Raleigh and colleagues at UCLA (1991) performed a valuable study that appears to significantly question the role of aggression in the acquisition of social dominance, at least in the case of vervet monkeys. Vervet monkeys were observed interacting in 12 socially organized troops consisting of three adult males, three or more females, and a variable number of young. In each troop, one male had assumed a dominant rank. The alpha male was removed from the troop, and the remaining monkeys were differentially treated, one receiving a 5-HT agonist or antagonist and the other given a placebo. Two treatment programs were implemented: one to increase 5-HT activity with fluoxetine or tryptophan, and the other to decrease it with 5-HT antagonists. During the various treatment phases, the pair was observed for changes in social behavior and rank. The experiment consisted of several phases and a treatment reversal in which monkeys receiving the agonist were given the antagonist and vice versa. The results showed that monkeys treated with fluoxetine or tryptophan consistently became dominant over cagemates given a placebo. Conversely, monkeys treated with a serotonin depleter (fenfluramine) or antagonist (cyproheptadine) consistently became subordinate to placebo-treated controls. The monkeys treated with fluoxetine or tryptophan consistently achieved a dominant status, even though they became less overtly aggressive, more friendly, and less active as the result of the treatment protocol. On the other hand, the monkeys treated with the antagonists were markedly more aggressive, less sociable, more active, and consistently became subordinate to placebo-treated cagemates. The monkeys treated with fluoxetine or tryptophan appeared to become socially dominant because of an improved ability to interact with other monkeys; that is, they became more socially competent. In an earlier study, Raleigh and coworkers (1985) found that the affiliation-enhancing effects of fluoxetine and tryptophan were facilitated by the social status of the monkeys treated. Dominant males were much more responsive to treatment with fluoxetine and tryptophan than were subordinate males. The researchers conclude that a high degree of independence exists between dominance and aggressiveness, with competent social interactions appearing to mediate social dominance.

Similar findings have been reported by Fonberg (1988). She found that previously submissive cats became dominant under the influence of chronic treatment with imipramine. The medication did not appear to have an effect on social dominance by raising aggression levels, but by some other mechanism, perhaps associated with an increase in predatory motivation and enhancement of the hedonic reward:

> Direct correlations between the gaining of dominance status and aggressive display were not found. Cats that became submissive as the result of DMA damage [dorsomedial amygdala lesions] regained their dominance under imipramine. It was suggested that imipramine enhanced dominance rather by increasing predatory motivation, and hedonic aspect of reward, than by raising the level of aggression. Some kind of "confidence" in the efficacy of action may also play an important role. The beneficial effect of imipramine in the treatment of depressive patients may reflect a similar mechanism. The increase of predatory behavior in normal or LH [lateral hypothalamus lesions] nonkillers under imipramine may also support the assumption that imipramine enhances predatory motivation. (208)

Not only is aggression not always necessary to establish and maintain dominance status, dominance maintained without aggression may result in more stable social relations. Fonberg concludes,

> The only conclusion which I can suggest is that aggression is not an indispensable factor for gaining and sustaining dominance, and that some unknown "dominance factor" is also a very important both for human subjects and other animals. (211)

Dominant dogs appear to be possessed by a dominant attitude and social competence, whereas aggressive dogs frequently lack confi-

dence, appear to be socially incompetent, and bite reactively under the disorganizing influence of confusion, irritability, frustration, or anger (see *Dominance: Status or Control* in Volume 2, Chapter 8). Fuller (1973) has reported that puppies exposed to early isolation suffer disturbances of attention, increased reactivity, and reduced abilities to habituate to environmental stimulation. He observed that isolated puppies were consistently dominated by better-socialized counterparts. Dominance is far more a matter of attitude than physical attributes, as stressed by Trumler (1973):

> Mental rather than physical superiority, whether in another of his kind or in man, is far more impressive to a dog. Between dogs which know each other well physical strength is always being measured, whereas authority remains unquestioned. (198)

Arginine Vasopressin, Testosterone, and Serotonin

In dogs, arousal and de-arousal patterns may be significantly different in the cases of predatory behavior, dominance aggression, and affective attacks motivated by anger and rage. In addition to relatively discrete circuits dedicated to quiet and affective attack, conspecific aggression exhibited during dominance contests between males appears to be mediated by a dedicated circuit, perhaps involving the combined influences of AVP and testosterone under the modulatory influence of 5-HT (Ferris et al., 1997). Whereas affective attack is strongly associated with anger and rage, dominance aggression between males competing for status and breeding rights does not appear to rely on anger and rage for its expression (Panksepp, 1998).

Various lines of research suggest a prominent role of AVP in the development of conspecific intermale agonistic behavior (see *Arginine Vasopressin and Aggression* in Volume 1, Chapter 3). The aggression-facilitating effect of AVP appears to depend on the presence of testosterone and testosterone metabolites (e.g., estradiol and dihydrotestosterone). Both vasopressin and testosterone are perinatally active, suggesting that they interact early in an animal's development and set the stage for dimorphic sexual and behavioral differentiation. The basic organismic plan of mammals is based on female characteristics, with the appearance of maleness depending on the influence of testosterone at various points in the development of an animal's ontogeny. In dogs, just before and after birth, the testes produce a surge of testosterone that exerts a pronounced differentiating influence on neural tissue via the aromatization of testosterone into estradiol by brain aromatase (Kelly, 1991). Estrogen-sensitive neurons are widely distributed in the brain, including limbic and cortical areas, exerting pervasive nonreproductive dimorphic influences on behavior. The perinatal influence of testosterone on neural organization becomes most evident at puberty, when another surge of testosterone occurs in the dogs at 6 to 8 months (Hart, 1985) and the emergence of dimorphic behavior associated with maleness, notably increased scent-marking behavior and intermale aggression, and secondary male characteristics begin to emerge. Under the influence of maternal stress, fetal changes associated with androgenization may be significantly disturbed (Panksepp, 1998), perhaps explaining somewhat the variable expression of male-characteristic behavior in adult dogs.

Testosterone and its metabolites interact with various neuropeptides. Most important, though, in terms of the expression of male-characteristic behaviors is its interaction with AVP. Along with CRF and the closely related peptide oxytocin, AVP is produced in the paraventricular nucleus of the hypothalamus. Oxytocin and AVP are also released into the bloodstream via the pituitary gland. AVP is also synthesized by neurons in the medial amygdala and the BNST. AVP production is sexually dimorphic, with males producing more AVP than females and expressing a greater number of androgen receptors in the medial amygdala (Cooke et al., 1998). Recall that the medial amygdala and BNST are closely involved in mediation of affective aggression, with the medial amygdala playing a central role in the rapid emotional interpretation of potentially dangerous situations. Males appear to be more risk prone, perhaps reflecting changes in the medial amygdala and other related neural areas influenced by the interaction of testosterone and AVP. The distribution of AVP receptors in the brain varies significantly from species to species,

which suggests that the neuropeptide plays a significant role in the differentiation of species-typical social behavior (Young, 1999).

In golden hamsters, AVP facilitates scent marking and offensive aggression, an effect that is dependent on the presence of testosterone in the ventrolateral hypothalamus (Delville et al., 1996). Earlier studies found that AVP mediates scent-marking behavior (flank marking) in hamsters when it is injected into the anterior hypothalamus. This behavior appears to be influenced significantly by social dominance, with dominant animals marking more frequently than subordinates. However, when subordinate hamsters are stimulated to exhibit more scent-marking behavior, the increased marking in the presence of a more dominant conspecific does not evoke offensive attacks or an increase in marking by the dominant animal (Ferris and Delville, 1994). Aggression can also be evoked by AVP in the anterior hypothalamus, an area enervated with a high concentration of 5-HT terminals and 5-HT_{1B}-binding sites interacting with AVP-responsive neurons. 5-HT is believed to perform an inhibitory role over offensive aggression and scent marking. Ferris and colleagues (1997) found that enhancement of serotonin activity with fluoxetine exerted a significant inhibitory effect on offensive aggression in experienced fighters. In addition, fluoxetine exerted a strong inhibitory influence over AVP-induced aggression directed against conspecific intruders. In the hamsters treated with fluoxetine, scent-marking behavior was completely suppressed.

Early stress may dramatically affect the activity of AVP and CRF. As previously noted, both AVP and CRF are produced in the same area of the hypothalamus and appear to interact at various levels of neural organization. As the result of postnatal stress, excessive AVP/CRF activity via the proliferation of AVP and CRF receptors in areas of the brain involved in the expression of affective aggression (e.g., medial amygdala, BNST, and PAG) may dispose some dogs show lower aggression thresholds. Stress associated with maternal separation has been shown to exert profound and lasting effects on the proliferation and density of CRF-binding sites, HPA dysregulation, and various functional disturbances of interacting neurotransmitter systems (see *Maternal Separation and Stress* in Chapter 4). In dogs, decreased glucocorticoid levels result in an increased release of peripheral AVP, with cortisol infusions producing a significant reduction of plasma AVP (Papanek and Raff, 1994). Cortisol may also restrain central AVP activity via negative feedback, a function that could be significant in dogs exhibiting aggression in association with low cortisol levels. Further, a cortisol-mediated reduction of AVP, the anti-diuretic hormone, may help to explain the loss of bladder control among many separation-reactive dogs and dogs experiencing stressful social and environmental transitions.

Immune Stress and Cytokines

Adverse emotional and mental states have been implicated in a variety of somatic disorders (McMillan, 1999), including gastric dilatation-volvulus in dogs—a condition that large, depressed, and fearful dogs appear to be at increased risk of developing (Glickman et al., 2000). Health and disease may also exert adverse effects on behavior. Serpell and Jagoe (1995) have reported the existence of a significant correlation between sickness in puppyhood and the subsequent development of behavior problems, including owner-directed and stranger-directed aggression, increased social fearfulness and reactivity, separation-related barking, and excessive mounting behavior by male dogs. A similar association between sickness in puppyhood and adult aggressiveness was detected among English cocker spaniels (Podberscek and Serpell, 1997). In both studies, the authors attribute the increased incidence of behavior problems associated with early sickness to various socialization deficits or excesses accruing as the result of the way sick puppies are treated by their owners (e.g., increased attention, care, and indulgence). However, another interpretation is also possible. Perhaps the positive correlation between early disease and an increased risk of behavior problems stems from the same root causes; that is, pediatric disease and adult behavior problems may be the short-term and long-term effects of early ontogenetic stressors. Murphree (1973) reported that nervous pointer dogs were

prone to develop mange between months 3 and 9, suggesting the possible involvement of stress-related immunosuppression (see *Nervous Pointers* in Volume 1, Chapter 5). Recently, Guy and colleagues (2001) have reported that dogs treated for pruritic skin disorders are at twice the risk of biting someone than are counterparts not exhibiting such problems.

Ongoing psychoneuroimmunological research indicates that a system of bidirectional communication exists between the brain and the immune system. Numerous classical conditioning experiments have demonstrated that the central nervous system exerts a conditioned modulatory influence over immune activity (Ader and Cohen, 1985). The immune system appears to interact closely with the FFS, perhaps as the result of an evolutionary process in which the stress system has co-opted by immune mechanisms that are conducive to supporting rapid preparation for emergency action (e.g., HPA activation) and promoting recuperation or reducing risk of infection from injuries incurred from fighting or other dangerous activities (Maier and Watkins, 1998). As the result of injury or invasion by a foreign substance, immune cells are activated. Immune cells perform a variety of complementary functions, requiring communication between cells and the rest of the body. This communication function is performed by a variety of substances called *cytokines*. Cytokines mediate immune responses to bacteria, viruses, and foreign proteins. Animals exhibit both specific and nonspecific immune responses. Specific immune responses take time to develop, but eventually provide the organism with lasting protection against the target antigen by producing antibodies. In contrast, nonspecific immune responses occur much more rapidly (within 1 to 2 hours). One type of nonspecific immune response involves the activation of a class of phagocytes known as *macrophages*. Activated macrophages perform many functions, including the synthesis and release of proinflammatory cytokines (e.g., interleukin 1, interleukin 6, and tumor-necrosis factor). In addition to facilitating a local inflammatory reaction, cytokines produce far-reaching changes throughout the body and brain. Within the brain, cytokines appear to increase NE and 5-HT turnover significantly—effects comparable to those produced by environmental stress (Dunn et al. 1999). These neural changes result in numerous affective, behavioral, and cognitive symptoms associated with sickness (e.g., fever, chills, reduced activity, increased sensitivity to pain, depression, and increased HPA-axis activity).

Since cytokines cannot freely pass through the blood-brain barrier, cytokine-mediated neural changes probably occur via another pathway, perhaps an active transport mechanism dedicated to specific cytokines. The exact route or routes of communication between cytokines and the brain is controversial (Blatteis and Li, 2000), but at least some communication between peripheral cytokines and the brain is mediated via afferent vagus-nerve transmissions (Romanovsky et al., 1997)—a pathway that may have been co-opted by epinephrine (adrenaline) to mediate the central changes associated with flight-fight activation. Whereas afferent vagal signals may activate central responses to immune stress, efferent vagal signals appear to modulate the effects of immune stress on the body (Borovikova et al., 2000), mirroring the opponent parasympathetic effects (decreased heart rate and so forth) that the vagus nerve exerts over sympathetic arousal and the FFS. According to this hypothesis, cytokines trigger afferent vagal signals that are carried to the brainstem (medulla) and relayed to various parts of the brain (e.g., hypothalamus and hippocampus), where they stimulate the synthesis and release of central cytokines. These substances, in turn, trigger a cascade of cytokine-dependent neural events that collectively produce the symptoms of sickness and distress. Studies examining the sensitization effects of cytokines on central monoamine neurotransmitter systems have shown that 5-HT activity in the central amygdala undergoes significant sensitization following exposure to immune stress, as does dopamine activity in the prefrontal cortex. Animals exposed to cytokine activation also show a marked increase in HPA-axis responsiveness to subsequent immune stress (Hayley et al., 2001). The sensitization mediated by immune stress, affecting neurotransmitter activity in brain areas associated with executive control, fear, and aggression, suggests that sickness and

disease might produce a lasting dysregulatory effect in some predisposed dogs, even after the sickness has completely passed. Further, perhaps chronic subclinical infections (e.g., Lyme disease) resulting in persistent immune stress and cytokine activation may alter behavioral thresholds controlling flight-fight reactions and adversely affect a dog's ability to cope with environmental stressors. Although nothing very persuasive has been published on the subject, adverse psychiatric symptoms of Lyme disease have been anecdotally reported in human patients (Fallon et al., 1993).

The possibility that immune stress in association with disease may produce lasting epigenetic changes in the dog's behavior offers an alternative explanation for Jagoe and Serpell's findings (Dreschel, 2002). Human psychiatric research indicates that some forms of rapid-onset obsessive-compulsive disorder in children may be related to a history of streptococcal infection (Swedo et al., 1998). In addition to obsessive-compulsive disorder and tic disorder, affected children often exhibit a variety of comorbid symptoms, including emotional and cognitive deficits, separation anxiety, hyperactivity, and increased oppositional behavior. Granger and associates (2001) have reported that stressing the immune system of neonatal mice causes them to become more socially reactive and fearful as adults. Conceivably, and this is a speculative leap, some predisposed dogs may be adversely affected by the immune stress associated with vaccinations—a hypothesis that deserves clinical and experimental attention (Dreschel, 2002). In the case of human patients, immune stress resulting from vaccination with live attenuated rubella virus has been shown to induce depressive symptoms in socially vulnerable teenage girls for up to 10 weeks following vaccination (Yirmiya et al., 2000). Since the neural response to immune stress is markedly sensitized by repeat exposure at a 1-day interval and not after a 28-day interval (Hayley et al., 2001), vaccinations given on a frequent schedule may be more prone to produce adverse cumulative effects than are vaccinations spread out over time. Even when dogs are vaccinated once a year, however, they show increased levels of fecal cortisol metabolites (417% above baseline levels) 1 to 2 days following injections (Palme et al., 2001), indicating an association of the procedure with stress-related activation of the HPA system. Finally, extrapolating from these investigations, one might reasonably assume that dogs and puppies may be more reactive to environmental and behavioral stressors for 24 to 48 hours following vaccination. Adverse behavioral effects following vaccination may be more likely in the case of dogs and puppies exhibiting unstable and reactive temperaments, especially when under the influence of heightened behavioral stress prior to vaccinations. The relationship between early stress, disease, immune-system activation, vaccinations, and behavior problems is an important area for future basic and epidemiological research.

Pharmacological Control of Aggression

Serotonergic medications are frequently prescribed to treat aggression problems in dogs, but the efficacy of such drugs to moderate or inhibit canine aggression remains controversial, with most studies to date indicating that tricyclic antidepressants (TCAs) perform on par with placebo. In addition, no compelling evidence currently exists showing that SSRIs perform any better. The TCAs most commonly prescribed to ameliorate behavior problems are amitriptyline and clomipramine. Amitriptyline appears to block the presynaptic reuptake of 5-HT and to an even greater extent the reuptake of NE, but its therapeutic effect appears to follow primarily from the sensitization of postsynaptic neurons. Clomipramine, on the other hand, is much more specific with regards to the inhibitory effect it exerts on serotonin reuptake. Whereas amitriptyline produces a twofold greater effect on NE reuptake than it does on 5-HT reuptake, clomipramine produces a fivefold greater effect on 5-HT reuptake than on NE reuptake, exceeding the potency of fluoxetine as a serotonergic agent by over twofold (Julien, 1995). Clomipramine appears to inhibit the reuptake of serotonin by means similar to that of SSRIs. As a result of elevated 5-HT activity associated with treatment, 5-HT$_{1A}$ autoreceptors located on the 5-HT neuron are gradually desensitized, thereby causing it to release

more 5-HT at the presynaptic terminal. Clomipramine, like other TCA drugs, may produce some typical side effects (e.g., mild sedation) and anticholinergic effects (e.g., dry mouth, urinary retention, and constipation), but to a lesser extent than amitriptyline, which can produce a potent histamine-related sedation effect (Julien, 1995). Despite an evident effect on 5-HT activity, neither clomipramine (White et al., 1999) nor amitriptyline (Virga et al., 2001) have been proven to be of clinical value for the treatment of owner-directed aggression. This is the conclusion of two double-blind and placebo-controlled trials performed to evaluate the efficacy of these commonly prescribed drugs. Neither study showed any significant benefit attributable to either medication; that is, dogs exhibited nearly the same behavioral course of change whether they were given the placebo or the TCA.

Perhaps the most commonly prescribed SSRI for the control of aggression in dogs is fluoxetine. The potential benefits of fluoxetine probably stem from a two-prong effect it appears to exert on 5-HT activity: decreased anxiety and lowered aggression thresholds (Olivier et al., 1991). Although probably effective in the case of aggression associated with impaired 5-HT function, no controlled study to date has shown that fluoxetine works any better than clomipramine for the control of owner-directed aggression or intermale aggression in dogs. Only one clinical trial to date has been performed to evaluate the effectiveness of fluoxetine for the control of dominance aggression (Dodman et al., 1996), but the quality of the study has been seriously questioned (White et al., 1999). The study involved nine dogs that were selected based on a history of owner-directed aggression. All of the dogs were given a placebo 1 week before commencing a 4-week course of treatment with fluoxetine. A significant reduction in aggression was found in all of the dogs after the treatment program was completed. Despite these promising results, the researchers failed to achieve their stated objective: "to determine the efficacy of fluoxetine in the treatment of owner-directed canine dominance aggression by means of a placebo-controlled blind study" (Dodman et al., 1996:1585). In fact, the study was neither blind nor placebo controlled, but rather an "incomplete-crossover design" (Simpson and Simpson, 1996:106), throwing into doubt the value of the results reported (White et al., 1999). Given the lack of efficacy shown by TCAs and the absence of more compelling evidence regarding the value of SSRIs, as things currently stand, the use of serotonergic drugs have not been definitively shown to be an effective treatment for household aggression problems.

TCAs and SSRIs may be more effective in cases where a significant disturbance of 5-HT or NE activity is indicated by the presence of high levels of anxiety and excitability, panic, and impulsiveness (Landsberg, 2001). When TCAs are given to normal humans, their mood is not enhanced by the medication; it is only in the presence of neural disturbances affecting 5-HT and NE functions that a benefit is obtained by their use. Although a previous study showed a strong relationship between decreased levels of CSF serotonin and dopamine metabolites and dominance aggression (Reisner et al., 1996), this potential endophenotype (i.e., a quantifiable physiological marker predicting risk or presence of disorder) predicting dominance aggression has turned out to be of limited clinical usefulness. Mertens and colleagues (2000) failed to find any significant differences in the plasma or CSF 5-HIAA or 5-HT concentrations of dogs presenting with dominance aggression (N = 9) and a control group of nonaggressors (N = 20), concluding that such markers are of little value for confirming the diagnosis of dominance aggression. Nevertheless, given the earlier work of Reisner and colleagues, such laboratory tests may still be of value for helping to detect the subgroup of dogs that might exhibit a deficiency of 5-HT activity and are most likely to respond beneficially to serotonergic agents. In their study, springer spaniels were disproportionately represented in the experimental group, suggesting the possibility that aggression problems exhibited by this breed may show an increased responsiveness to serotonergic medications.

SSRIs often take weeks to become fully effective, even though the presynaptic reuptake inhibition produced by such medications

(e.g., fluoxetine) appears to occur within minutes (Blier and De Montigny, 1994). The rapid increase of 5-HT occurring as the result of treatment with fluoxetine causes 5-HT_{1A} autoreceptors at the level of the midbrain raphe nuclei to slow down the release of serotonin at the terminal, where 5-HT_{1B} autoreceptors also exert an inhibitory effect on the release of serotonin. This braking effect is gradually reduced as 5-HT_{1A} autoreceptors are slowly desensitized, thereby attenuating their negative-feedback control over 5-HT release. To induce a more rapid onset of therapeutic effect, pindolol, a mixed ß-adrenoceptor/5-HT_{1A} antagonist has been used in combination with SSRIs to treat human depression. Reportedly, the combination both accelerates and enhances the effects of SSRIs. Pindolol may facilitate SSRI actions by partially inhibiting 5-HT_{1A} autoreceptors and other modes of action (Artigas et al., 2001), for example, central ß-adrenoceptor blockade (Cremers et al., 2001). Since pindolol exerts an inhibitory effect over 5-HT_{1A} receptors, it *may* elevate anxiety levels while exerting a more rapid onset of modulatory control over aggressive impulse.

Given the effectiveness of fluoxetine to modulate offensive aggression, scent marking, social dominance, and affiliative behavior in several animal species, perhaps 5-HT-enhancing drugs would be useful to control dog-dog aggression, especially aggression between dogs sharing the same home (Houpt, 2000). Also, fluoxetine or 5-HTP might offer significant benefit for the control of refractory canine urine marking, as Pryor and colleagues (2001) have convincingly shown in the case of fluoxetine for the control of feline urine-marking behavior. Both fluoxetine and 5-HTP have been shown to stimulate an increased production of glucocorticoids, an effect that may be beneficial in cases of aggression associated with low cortisol levels. Finally, a potent selective 5-HT-reuptake inhibitor that may have potential value for the treatment of stress-related behavior problems occurring in association with dysregulated 5-HT activity is paroxetine. Paroxetine may be particularly beneficial in the case of dogs exhibiting signs of chronic stress or abnormalities involving the HPA system (e.g., low cortisol). Reportedly, paroxetine exerts a pronounced effect on central CRF, helping to normalize the HPA axis and promoting a more adaptive response to stress (Ladd et al., 2000).

In accordance with the dead-dog rule (see *Dead-dog Rule* in Volume 2, Chapter 2), most treatable aggression problems are best approached by training owners and dogs how to get on together more competently and affectionately, rather than targeting aggression with physical punishment, mechanical restraint, or pharmacological suppression. Given that the mere absence of aggression is not a particularly reliable predictor of risk, emphasis is placed on mediating changes conducive to more competent, playful, relaxed, and friendly interaction between the owner and family members. Establishing a pattern of behavior, with or without the support of drugs, that is incompatible with aggression appears to provide a far better predictor of relative aggression risk, but nothing is fail-safe in such matters. Many drug-study protocols appear to be overly preoccupied with the suppressive effect of medication rather than focusing on the subtle nuances and changes occurring in the dog's emotional tone and emergent organizing processes that may, in fact, be facilitated by the medication but remain undetected by the assessment instrument used to monitor change. Medications such as SSRIs may steadily enhance a dog's ability to cope more adaptively with stressful situations and to interact more competently and affectionately with the owner. Many of the neurobiological effects of SSRIs, in particular, appear to be mostly subtle, working slowly and thereby integrating a complex attunement process involving a dauntingly complicated network of serotonergic processes and neural interactions. For the full benefits of such therapy to develop and mature, perhaps the medication needs to be maintained for much longer periods than typically found in current protocols. Drug trials lasting only a few weeks—that is, ending just at a point when the drug is becoming most potent and active—may not be provide enough time to reveal the full merit of SSRI therapy on dog aggression problems. Further, more sensitive and standardized assessment instruments may need to be developed for detecting and track-

ing gradual behavioral changes. Finally, it seems crucial that efforts be taken to develop sharper diagnostic inclusion criteria and endophenotypic markers for sorting out aggressive phenotypes in order to determine which ones might benefit most from SSRI therapy:

> It is possible that in dogs, aggression that is a typical, albeit problem, behavior will not be affected by serotonergic drugs, but abnormal aggressiveness, which develops less frequently in dogs, may be affected. (White et al., 1999:1290–1291)

Note: The foregoing information is provided for educational purposes only. If considering the use of medications to control or manage a behavior problem, the reader should consult with a veterinarian familiar with the use of drugs for such purposes to obtain diagnostic criteria, specific dosages, and medical advice concerning potential adverse side effects and interactions with other drugs.

PLACEBO EFFECTS, ENDOPHENOTYPES, AND THE DEAD-DOG RULE

White and colleagues' (1999) data revealed a robust placebo effect occurring precisely in the treatment time course when one might *expect* to observe maximum benefits resulting from treatment with clomipramine or SSRIs, a pattern consistent with the positive findings reported by Dodman and colleagues (1996). Interpersonal expectancy effects in the treatment of aggression problems can be extremely powerful and sometimes even welcome and beneficial, appearing to exert a constructive influence that a skillful behavior therapist can use to promote positive change. However, in the case of research, placebo effects make it impossible to interpret the significance of the data collected, essentially making the work useless or, at best, stimulating additional research with appropriate controls to limit placebo and experimenter-bias effects.

Most veterinary behavior data are collected secondhand via questionnaire instruments, filtered through the owners' perception of their dog's behavior and its response to treatment. In addition, the owner is typically asked to perform some set of procedures, not to interact with the dog in some specified ways, or not to change their behavior toward the dog in any way. In a sense the owner becomes a coexperimenter, often fully aware of what the experimenter is trying to achieve by way of the study. Naturally, the owner's involvement jeopardizes the objectivity of the study at various points. Many owners desperately want their dogs to improve and may do things unconsciously to facilitate that improvement or begin to see changes where none have actually occurred, thereby potentially skewing what they observe with an overly optimistic bias. As a result, three basic concerns are raised by such studies: (1) owner reports may lack objectivity, (2) owners may not follow instructions competently or compliantly, and (3) study results will tend to confirm the experimental hypothesis. Without the safeguards afforded by a randomized, double-blind, and placebo-controlled experimental design, findings derived from such investigations are extremely difficult to analyze and interpret, perhaps ending up being a waste of time and money. Even with the proper controls in place, problems might still stem from items 1 and 2. These almost insurmountable difficulties point to the need for objective physiological or neurobiological markers or endophenotypes correlated with serious behavior problems and their resolution. Studies evaluating PPI testing, heart-rate changes in response to petting and massage, stress-related heart-rate and blood-pressure divergence (*see Autonomic Arousal, Heart Rate, and Aggression*), oxytocin levels in response to social contact/petting, cortisol response to mild stressors, blood-pressure and vagus-nerve monitoring, and so forth may prove useful in this regard. For example, SSRIs appear to mobilize an oxytocinergic-antistress response (Uvnäs-Moberg et al., 1999), an effect that may alter a dog's PPI and cardiac response to touch, thereby potentially establishing an objective marker (endophenotype) for gauging the efficacy of such medications. A chronic effect of clomipramine is to downregulate kappa- and mu-opioid receptors, suggesting the possibility that one therapeutic effect of the medication is to reduce opioid-mediated inhibition of central oxytocin

(McDougle et al., 1999), an effect that should be reflected in changes of peripheral oxytocin levels (see Brown et al., 2001).

The stated goal of cynopraxic therapy and training is to promote interactive harmony and to enhance the human-dog bond, but how can one quantify such an objective? For practical purposes, success is quantified by informal and formal assessments and comparisons of pretraining and post-training expectancy divergence and convergence indicators (see *Puppy Profile Sheet* in Volume 1, Chapter 2). For example, during pretraining interviews, the owner may be instructed to list on one side of a sheet of paper all of the dog's minor and major adjustment problems and on the other side a collection of corresponding positive statements about what the owner would consider the best possible outcome of training efforts. The owner is then instructed to draw lines between the two sets of items, connecting related items and thereby establishing a series of expectancy continuums between the owner's ideal and the dog's actual behavior. These items can then become the topic of counseling to form realistic objectives and means to attain the owner's goals. A major advantage of this approach is that it establishes a personalized profile of the dog's specific adjustment difficulties from the owner's perspective and in terms relevant to the owner's goals. Not only do dogs exhibit significant variability, relationships between people and dogs are also affected by tremendous variation. What may be a problem for one person may be a source of joy for another. The profile helps to contextualize the dog's behavior within a relationship and a home, thereby enabling the cynopraxic therapist to provide counseling and rational training relevant to improving the human-dog bond while simultaneously working to enhance the dog's quality of life.

This procedure not only provides vital information about the adjustment problem, but allows the owner to think through carefully what he or she wants to achieve as the result of training and behavior therapy. The set of expectancy continuums given by the owner can be formalized and used to construct a worst-case and best-case grouping of related items with a 10-point scale between them, as used in the puppy profile questionnaire. With regard to experimental applications and data collection, the owner's items might be included in a standardized and validated owner-expectancy assessment developed for research purposes—something that remains to be done. At a glance, the owner can quickly note where the dog currently stands on the scaled continuum with an X and indicate what he or she would like to accomplish through training by placing an O over the appropriate point. The divergence between these two points on the scale is the expectancy-divergence score. Upon completion of the training and therapy program, a second owner-expectancy assessment is performed, and a training outcome score is assigned by comparing and recording differences between the pretraining scores and the post-training scores. By adding these scores together and then dividing the sum by the total number of items in the assessment, a social-conflict score is yielded. Success is measured in terms of a progressive trend toward a convergence between the owner's expectations and what the dog does, indicating a reduction of interactive conflict. In addition, quality-of-life improvements (e.g., time in crate, time on walks, time playing, and time training) are tracked by having the owner keep relevant records. This method of assessment is consistent with the dead-dog rule and seems to provide a valid measure of change relevant to the improvement of the human-dog bond.

PART 2: DEVELOPMENT AND CONTROL OF PUPPY COMPETITIVE BEHAVIOR

TEMPERAMENT AND AGGRESSION

Organized activity depends on the presence of an emotional balance produced by the complementary influences of inhibition and excitation. In addition to adverse developmental experiences, some dogs appear to be influenced by a genetic predisposition toward emotional instability and reactivity, corresponding to what Pavlov described as the choleric temperament (c type) (see *Experimental Neurosis* in Volume 1, Chapter 9).

Such dogs may be significantly more prone to exhibit behavioral disturbances associated with social environmental stressors (see *Temperament Testing* in Appendix D). These differences appear to express themselves at an early age in wolves (MacDonald, 1983) and dogs (Senay, 1966). Senay found that puppies prone to high levels of emotional arousal and reactivity were more avoidant and aggressive when approached than were puppies showing a more relaxed and organized response to human contact. These temperament differences were apparent at an early age and persisted throughout the first year, suggesting that they may due to inherited deviations affecting arousal levels and stimulus-reactivity thresholds. A proneness to excessive excitability and reactivity may cause dogs to engage in more disorganized and reactive behavior (withdrawal, avoidance, and aggression) when stimulated by social contact, whereas dogs functioning under the influence of moderate arousal and relaxation may be more prone to engage in organized behavior (approach, affiliation, and cooperation) under the influence of similar social stimulation. In addition to social avoidance and aggression, puppies exhibiting emotionally reactive behavior showed physiological signs of autonomic arousal (e.g., tachycardia and submissive urination). Puppies genetically prone to disturbances associated with excitability and reactivity excesses may also be more susceptible to the harmful influences of adverse rearing practices and biological stress.

TACTILE STIMULATION AND ADAPTATION

Tactile experiences and emotions share a number of common characteristics that suggest an ontogenetic link between taction and the development of emotional responsiveness and tone. Both touch and emotion are hedonically valenced and associated with varying degrees of subjective pleasure or pain; they both produce motivationally short-lived arousal prompting immediate behavioral adjustment (attraction or aversion) or more lasting and inescapable discomfort (e.g., throbbing pain or hurt feelings); they both function to direct dogs to attend to and respond to environmental stimulation selectively in order to perpetuate or terminate it; and they both can function as means to reinforce or suppress behavior.

Early tactile stimulation in the form of handling and gentling exerts profound and long-lasting influences on health (resistance to disease), activity levels, learning and problem-solving abilities, confidence, and emotional reactivity. Tactile stimulation is a significant source of potential reward for puppies and dogs (Fonberg et al., 1981), cats (Wenzel, 1959), and rats (Burgdorf and Panksepp, 2001). Rats seem to enjoy tactile stimulation as a prelude to play, with tickling of certain skin areas inducing ultrasonic chirping (Panksepp and Burgdorf, 2000). Among puppies, tactile stimulation associated with play enhances affection, social expressiveness, empathy, and restraint (bite inhibition). Just as tactile stimulation can produce disorganized and reactive behavior as the result of neurotogenic or traumatic experiences, therapeutic procedures using tactile stimulation appear to be highly effective in treating emotional disturbances originating in adverse somatosensory experiences (see *Posture-facilitated Relaxation Training* in Chapter 7).

Somatosensory systems promote attachment and social bonding via proximity seeking contact comfort and affect attunement. Puppies exhibit a strong preference for contact with soft objects, spending more time with cloth surrogate mothers versus time spent with wire surrogates providing milk (Igel and Calvin, 1960). Other studies have shown that contact with soft objects produces a significant reduction in separation distress in isolated puppies (Pettijohn et al., 1977). Petting has been shown to modulate adverse emotional reactions (Gantt, 1944; Fuller, 1967), restrain HPA-system activity (Hennessy et al., 1998), and decrease physiological arousal associated with aversive stimulation (Lynch and McCarthy, 1967 and 1969). Tactile stimulation mediates a potent effect on emotional learning and reactive thresholds via the autonomic nervous system and endocrine activity. The emotions associated with touch selectively activate and organize a puppy's behavioral output in the opposing directions of approach or withdraw in response to social

and environmental sources of tactile stimulation. Tactile-related emotions exert a pervasive influence on social behavior and development. Close social contact and tactile stimulation produce conditioned and unconditioned effects on attractive (e.g., affection) and aversive (anxiety, fear, irritability, and anger) arousal thresholds, mediating the expression of both organized and reactive behavior. Gantt (1971) observed that close contact and tactile stimulation produce three general patterns of arousal in dogs, depending on temperament and past experience: calming, agitation, and autistic (little or no response as observed in many genetically nervous pointer dogs). These differences in responsiveness are reflected in overt behavior, canine cardiovascular activity (e.g., heart rate and blood pressure), respiration rate, and endocrine activity.

As a result of the close and active social interaction with the mother and littermates, puppies may acquire somatosensory set points for a certain type and quantity of tactile stimulation not provided in the new home. Failure to obtain sufficient tactile or locomotor stimulation may represent a significant source of stress for newly adopted puppies, perhaps inducing a variety of compensatory behavioral changes, including hyperactivity, excessive contact-seeking and proximity-seeking behavior, overexcitability, and increased aggressiveness associated with frustration and irritability. Slabbert and Rasa (1993) have reported that German shepherd puppies removed from their mothers at week 6 failed to thrive and showed a significantly greater risk for disease and mortality than did puppies naturally weaned by their mothers between weeks 7 and 8. They also exhibited significant behavioral deficits: "Puppies weaned before 7 weeks of age are noisy and nervous. These seem to become fixed characteristics of the dog for life" (5). Puppies allowed to stay with their mothers through week 12 were healthier, gained more weight, and appeared better adapted. The cause of these disturbances in early-weaned puppies may be related to the premature loss of tactile stimulation and comfort contact.

Early adverse stress may exert immunological effects (e.g., immunosuppression) that could compromise a puppy's ability to fight infection. Although it is difficult to estimate the effect of postnatal stress on puppy development and the etiology of behavior problems, perhaps some important clues may be obtained by the confluence of early disease conditions, immune stress, and the incidence of adult behavior problems (see *Immune Stress and Cytokines*).

Play, Discipline, and Dominance

Dog owners typically establish dominance by asserting authority and setting behavioral limits on their puppies' activities. When confronted assertively, most puppies acknowledge the owner's authority and submit to owner directives. Although puppies are capable of learning at an early age, mature impulse-control abilities probably do not fully develop until dogs are 8 to 10 months of age. The most prominent ways in which owners respond to inappropriate behavior is by physical assertion (dominance) or by encouraging cooperation (leadership). Whether an assertion of physical force or encouragement is used largely depends on the owner's perception of the problem and the sort of motivations attributed to it. Ben-Michael and colleagues (2000b) found that assertions of force were most likely to occur in situations where the dog was perceived as being disobedient or out of control, both of which frequently evoked anger and irritability in owners. Encouragement and comforting strategies were most common in the case of fearful and submissive dogs and were motivated by feelings of compassion and anxiety. Some owners, however, may perceive fear-related behavior as personally aversive or offensive (e.g., a submissive dog urinates), thereby intensifying feelings of anger and irritability and reducing the likelihood of comforting activities toward the dog. The most common techniques used by dog owners to handle problematic behavior were mostly punitive (e.g., demand obedience, yell at the dog, or distract it). Comforting and encouraging the dog or ignoring the problematic behavior was less common. The least commonly used strategy was reward—findings that appear sharply at odds with the data and

assumptions elaborated by Hiby and colleagues (see *Owner Control Styles and Welfare Agendas* in Chapter 10). Physical punishment was mostly used in the case of aversive behavior (e.g., chewing on personal belongings or jumping on a bed) or disobedience. Punishment was avoided in situations where the dog was overexcited or fearful, in which cases owners were more likely to use distraction techniques (Ben-Michael et al., 2000a).

A significantly different picture of training and disciplinary activities has been presented by Koda (2001b) with regard to the ways in which guide-dog puppy raisers cope with inappropriate behavior. A series of direct observations of puppy raisers indicated that they rarely hit puppies and relied primarily on diversionary activities (e.g., play) or rejecting behavior (e.g., brief withdrawal of contact from the puppies) to control social excesses (e.g., mouthing). During observation periods, rejecting and, to a lesser extent, ignoring were considered to be effective in controlling biting, whereas distraction, talking to the puppy, initiating play, restraint, and showing objects to the puppy were all ineffective. These findings are difficult to interpret because of the way in which the observations were made. The presence of the observer, together with specific instructions from the guide-dog association not to use physical punishment, may have caused the puppy raisers to behave differently during observation periods than at other times when alone with the puppy. Koda has noted, however, that Japanese mothers typically avoid making their children behave by asserting authority, as "compared with American mothers" (86) (and apparently Dutch ones, too), suggesting the possibility that, in fact, the puppy raisers did avoid the use of physical punishment. Of particular interest was the finding that puppies may have exhibited an ontogenetic decline in biting and destructive activity as they matured, showing increased gentleness and willingness to cooperate. These maturational aspects of social interaction are particularly evident in the development of play behavior. Koda (2001a) found that, as puppies grew older, they tended to engage in play activities that evidenced improved impulse-control abilities. Unfortunately, it is impossible to determine whether these enhanced abilities for cooperative play are the result of ontogenetic changes or the result of puppy-raiser training activities occurring between observation periods.

Establishing dominance by setting limits on a puppy's behavior is typically accomplished by the application of varying amounts of punishment, a method of social control that is widely practiced by animals (Clutton-Brock and Parker, 1995) and the most common strategy used by people to control dog behavior (Ben-Michael et al., 2000a). Although assertive disciplinary interaction may be necessary and helpful to prevent problems (Hart and Hart, 1997), excessively harsh or frequent punishment is inappropriate and should be avoided. In response to such treatment, puppies typically show varying degrees of fear and submission, but some may be stimulated by frustration or anger and fight back. Defining and enforcing social rules for a puppy is critical for the development of appropriate adult social behavior, but excessive punitive interaction may cause the puppy to become progressively insecure and dependent on the owner or more reactive and aggressive. The risk of forming insecure attachments and excessive reactive coping styles is especially likely in situations where punishment is also associated with high levels of indulgent pampering, something that often follows severe punishment as the owner is moved by pangs of compunction and sympathy for the emotionally injured puppy.

Given the puppy's immature abilities with respect to exercising impulse control, punishment is unlikely to control social excesses effectively. As a result of limited success and growing frustration and irritability, owners and trainers may be tempted to escalate punitive efforts beyond what is appropriate and beneficial. Assertions of control using restraint, response prevention, abrupt stimulus change, assertive blocking, and loss of social contact may be effective, but physical punishment (e.g., hitting) should be avoided. Most importantly, in addition to defining what a puppy must not do, it is imperative to guide the puppy toward the expression of behaviors that it can do. Ideally, inhibitory training should be minimized. The puppy trainer should follow a philosophy of maximum overt differentiation (MOD) and systematic canalization of behavior into more

socially acceptable variations through structured play activities. Gradually, behavior-selection pressures involving contingent reinforcement and punitive actions can be used to shape a more precise and predictable behavioral repertoire. Young puppies are particularly receptive to incentive-based training, especially activities that involve play, small treats, and affectionate encouragement. Play provides an ideal means for controlling social excesses and inappropriate behavior by guiding puppies into alternative activities (canalization) to obtain gratification for otherwise socially unacceptable behavior (e.g., biting and jumping up). Play training promotes cooperative interaction based on a leader-follower bond, mutual appreciation, and heightened interactive joy. Disruptive, aggressive, or impulsive behavior is best controlled through the differential reinforcement of incompatible behaviors, response prevention, restraint, and brief TO. In addition to play, affectionate petting, vocal encouragement, and food rewards given in exchange for the performance of basic exercises (e.g., sit, down, stand, come, and stay) help puppies to learn how to communicate and cooperate with people. Integrated compliance training (ICT), whereby training is integrated into everyday household activities, helps to structure a puppy's behavior in accordance with general rules and expectations.

Precocious Aggression Problems

Although severe aggression problems are seldom seen in puppies, occasionally puppies do exhibit serious problems requiring behavioral intervention (see *Social Competition, Development, and Aggression* in Volume 2, Chapter 8). A common form of pediatric aggression involves possessive guarding of objects or food—a significant concern for families with children. Overly possessive puppies may guard food or other prized objects and threaten to bite if they are approached at such times. Training puppies to drop ("Drop it"), back away ("Leave it"), and resume possession ("Take it") of highly attractive toys and chew items is among the most important early lessons for such puppies to learn. Possessive-aggressive behavior in puppies may be indicative of a temporary developmental impulse-control deficit and may not necessarily predict adult possessive-aggression problems. Many puppies exhibiting possessive aggression appear to grow out of it (Marder, personal communication, 2000), but many also continue to exhibit the behavior as adults. Dunbar (1978) reported that adult male beagles rarely attempt to take bones away from young puppies, but always take them away from 7-month-old ones. This observation may be related to the ontogenetic emergence of improved impulse-control abilities in adolescent dogs. Adult dogs may recognize that puppies simply cannot control the impulse to protect such possessions.

As the result of biogenetic and experiential causes, some puppies may show more ominous signs at an early age (e.g., low fear and aggression thresholds). Evidence of excessive fear, irritability, and aggressiveness may reflect inchoate epigenetic processes, possibly prefiguring adult aggression problems (see *Behavioral Thresholds and Aggression* in Volume 2, Chapter 8). Puppies exhibiting such behavioral signs should be identified as early as possible and provided with appropriate supportive training and behavior therapy. Adult aggression problems depend on both genetic and experiential factors to incubate. Although genetic influences may put a dog at risk of developing a serious aggression problem, the risk can be significantly reduced by the presence of ameliorating or protective influences (Figure 6.3). In contrast, adverse social and environmental influences may significantly increase a dog's risk of developing aggression problems.

Competitive Social Excesses

Arguably the most common reason for seeking behavioral advice and training is aggressive play, including mouthing, biting, and chase-grabbing activities (see *Play and Aggression* in Volume 2, Chapter 8). Competitive playful excesses do not appear to be significantly correlated with adult aggression problems (Goodloe and Borchelt, 1998); however, such behavior may forecast oppositional tendencies, hyperactivity, and various discipline problems, stressing the importance of early behavioral training to head off secondary

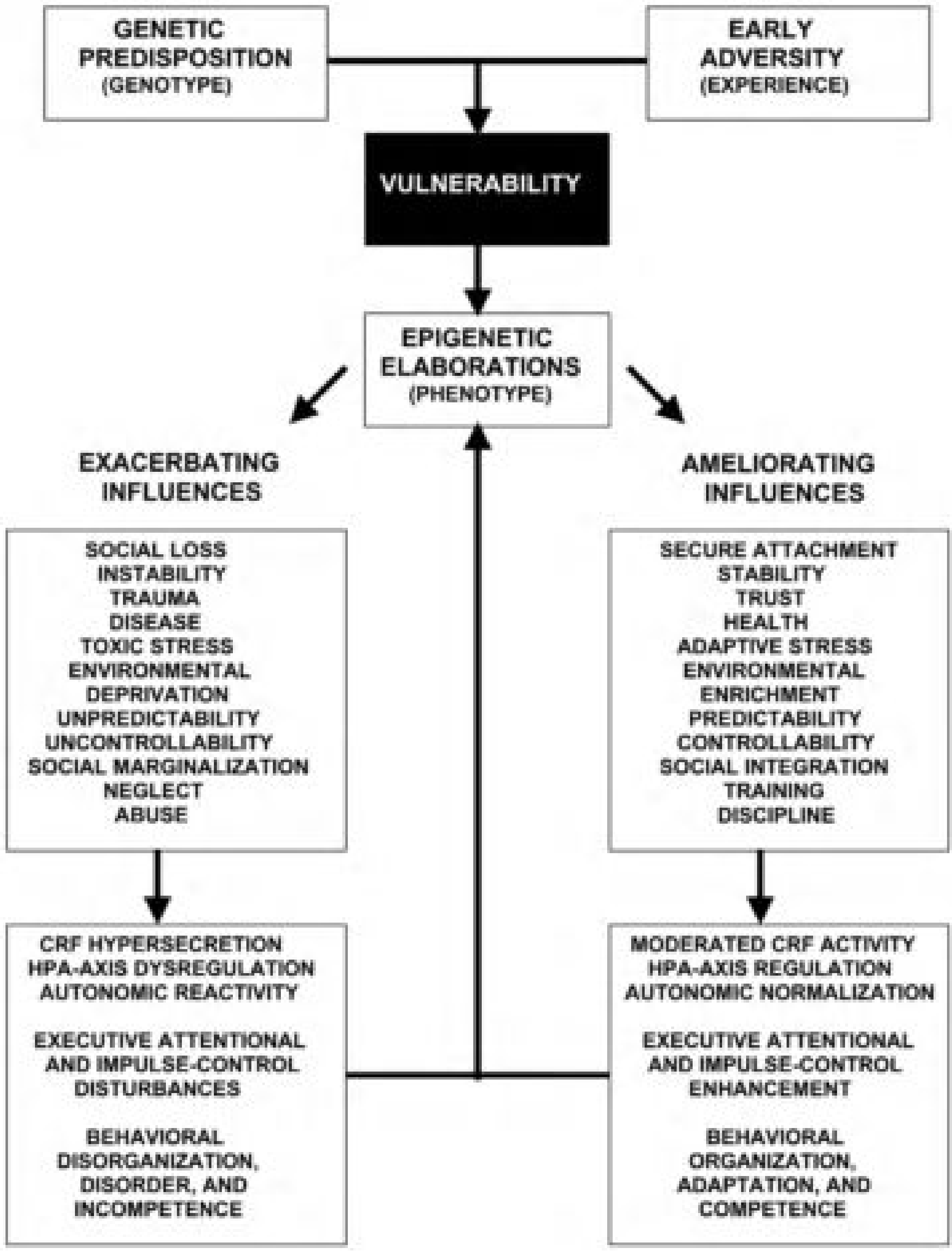

FIG. 6.3. Biogenetic and developmental predisposing influences may make a dog vulnerable to exhibiting aggression or other serious behavior problems in adulthood. Such problems are not inevitable, however, since subsequent experience (epigenesis) exerts a pronounced influence on how the predisposition manifests itself, determining whether a stable or unstable behavioral phenotype emerges. Serious behavioral problems are expressed through several layers of causation (biogenetic, ontogenetic, and epigenetic), resulting in physiological, neurobiological, and behavioral changes. Ameliorating influences may exert a protective effect against the development of aggression problems, whereas exacerbating influences place a dog at greater risk. CRF, corticotropin-releasing factor; and HPA, hypothalamic-pituitary-adrenocortical.

problems associated with excessive or disruptive competitive behavior. The key to successful puppy training is to occupy the puppy with structured play and positive learning activities. Even in cases where signs of aggression are not evident, training puppies to actively defer to human leadership should still be a prominent aspect of everyday handling and socialization. Many puppy problems involving overactivity and excessive playfulness can be rapidly improved by a combination of play therapy and increased opportunities for exercise.

The causes underlying disruptive competitive behavior are numerous and varied. Social learning is undoubtedly a factor, but difficult puppies may also be affected by a genetic predisposition and temperament traits that compete with the acquisition of behavior needed to adapt successfully to the home environment. In addition to reduced thresholds for fear, frustration, irritability, and aggression, some puppies appear to exhibit an inability to achieve sufficient reward stimulation from everyday activities (see *Neural and Physiological Substrates* in Volume 2, Chapter 5). These puppies cannot seem to get enough attention and contact and may be driven by an exaggerated and insatiable appetite for reward gratification. Stimulation-seeking puppies exhibit excessive attention needs, impulsive competitive tendencies, signs of inappropriate appetitive interests (pica), and an overall inability to achieve a normal degree of gratification and contentment from reward-producing activities, suggesting a developmental reward-processing deficiency. In such cases, it is especially important to use methods emphasizing positive reinforcement and ICT. Unfortunately, disruptive puppies are often treated with abusive physical punishment. Although limit-setting actions and TO may be useful, physical punishment involving the slapping or hitting of difficult puppies should be avoided. Most puppy owners are searching for answers that will give them enhanced control without resorting to abusive or excessively aversive techniques.

Mouthing, biting, and pawing on hands and clothing are common puppy nuisances. These playful competitive habits are normally acquired as the result of play fighting between littermates. Playful sparring and other contests involving the use of the mouth and feet constitute the most frequently observed active interactions between puppies. This playful interaction serves many vital functions, ranging from physical and sensory development to the elaboration of various social and competitive skills. Much of what puppies do during play facilitates learning how to use ritualized threat and appeasement displays competently. An important function of competitive play is to ritualize aggressive contests, thereby bringing about a more or less stable social organization among littermates. Puppies learn how to restrain their aggressive impulses and bite in order to perpetuate the joys of play. Under the influence of competitive play and social feedback, a puppy learns to be affectionate and restrain its aggressive impulses toward its playmates. In several respects, the interactive dynamics embodied in the litter are prototypical social behavior patterns exhibited by adult dogs and wolves. Playful fighting allows canine competitors to practice skills that might otherwise result in injury, increase social conflict, or disrupt the unity of the group. Puppies are conditioned to play fight affectionately, and significant benefits for the human-dog relationship may be obtained by engaging them in structured play activities.

However, some puppies may develop a rather compulsive interest in competitive behavior, engaging in persistent rough mouthing and biting whenever handled by the owner. Even though the presence of heightened excitability and competitiveness does not necessarily prefigure adult aggression problems, it appears to represent a significant risk factor (Guy et al., 2001) that warrants training and preventive efforts introduced at an early age. Competitive excesses may make puppies less enjoyable and adversely impact on the bonding process. A competitive puppy may intimidate children, frustrate adults, and create significant household tensions, gradually becoming the object of escalating punishment. Owners seeking help with disruptive puppies are often distressed and worried about the behavior. Some owners may express regrets about having obtained a dog, further emphasizing the potential injury that such behavior can have on the developing bond

between the family and puppy. Instead of moving toward the center of family life, a highly excitable and disruptive puppy may be swept outward on a trajectory of progressive rejection and isolation. Instead of spending constructive time with the family as a source of affection, comfort, and entertainment, a difficult-to-control puppy may spend the majority of time in a crate, behind gates, or kept outdoors. Under such circumstances of excessive confinement and isolation, a puppy's undesirable behavior may worsen and threaten to result in its removal from the home unless something can be done rapidly to ameliorate the situation.

Restrain and Train

Obviously, it is critical to offer such families immediate and effective means for establishing control. Suggesting that they keep the puppy on a leash while indoors can be extremely beneficial. Surprisingly, many inexperienced dog owners may not have thought of this simple solution. For disruptive and hyperactive puppies, the leash facilitates control by means of passive restraint, response blocking, and limit-setting directives. Overly active puppies appear to learn much more effectively and rapidly when the range of possible actions that they are free to perform is limited. Leash control limits the amount of behavior that fails while increasing the amount that succeeds. Rather than the owner engaging in pointless yelling and other reactive and ineffectual expressions of frustration, the leash offers a more direct and communicative means to establish control and guide a puppy's behavior. In an important sense, the leash represents a reification of the human will, helping to constrain and conform the puppy's behavior toward a more acceptable social ideal. Actions prompted by the leash can be reinforced and brought under the control of vocal signals. For example, stepping on the leash can easily block common jumping-up excesses. Pairing the word "Off" just as a puppy attempts to leap up becomes associatively linked with the thwarted action. Combining such mild avoidance training and response-blocking techniques with positive reinforcement of alternative behavior, such as standing or sitting, encourages puppies not to jump up when excited or seeking attention. Instead, puppies learn that obtaining attention or contact is best achieved by waiting or sitting or by exhibiting some other behavior that has worked in the past to produce positive reinforcement.

In addition to leashing puppies, tie-out stations can be set up throughout the house, especially in places where family members frequently gather to spend time together. Tie-out stations can be particularly useful for children, who might otherwise be overwhelmed by an overactive and uppity puppy. Such restraint provides sufficient control for them to get close to the puppy to feed it small treats by hand, pet it, and play with a toy. Initially, the puppy is trained to lick a closed hand to produce a concealed treat. As the puppy licks, the child can say "Kiss" and "Good puppy," thereupon giving the puppy the treat. In addition, with very little instruction, the puppy can be taught to sit and lie down by closely following the child's closed hand and getting a treat after completing the action. If the puppy becomes overly active or intrusive, the child can simply scoot back out of the puppy's reach, thereby initiating a brief nonexclusionary TO. As the puppy subsequently calms down, the child can return and continue the gentling process. Under the influence of such contingent pressures, the puppy soon learns that excessive or intrusive behavior results in the withdrawal of contact and the opportunity to obtain more food and affection, whereas self-control and cooperation result in the resumption of contact and the chance to get more food and attention. For puppies that engage in persistent mouthing or precocious aggression problems, more assertive procedures may be necessary. An active-control line can be set up enabling the trainer to turn the puppy away and restrain it at a distance for a brief TO period before allowing it to approach again and initiating reward-based training activities incompatible with biting. If the puppy engages in the undesirable behavior, it can again be turned away briefly (e.g., 20 to 30 seconds). Play activities, orienting and attending training, sit-stay, and down-stay training can be highly

effective in helping to organize the behavior of such puppies.

Learning to Succeed

All normal dogs strive to optimize their control over the social and physical environment in order to attain adaptive success and security. Fundamentally speaking, behavior is purposive and organized to achieve some useful goal, usually involving the enhanced prediction and control over significant attractive or aversive environment events. Consequently, behavior is selected (punished or reinforced) in accordance with its relative success or failure to predict and control significant events: behavior that fails is modified, extinguished, or suppressed, whereas behavior that succeeds is perpetuated. Obviously, success is preferred over failure, but failure is not without benefit. Without Pavlovian prediction errors and instrumental failures, learning to predict and control the environment would not proceed efficiently. Prediction errors and failures provide information that can be used to improve future efforts, which ultimately serve the purpose of enhancing an animal's adaptive success. Nonetheless, dogs do not set out to fail when they purposively interact with the environment, and when they do fail to predict or control some significant event causing them loss or discomfort, they may experience a variety of hedonically aversive emotional states (e.g., disappointment, irritability, frustration, anxiety, or fear). Normally, behavioral efforts that fail are usually followed by additional attempts and variations emitted under the potentiating influences of frustration or fear. Depending on a puppy's temperament and motivational predisposition, the quickening influences of frustration and fear may result in either adaptive or reactive efforts to control the environment. Although some failure is instructive and beneficial for learning, excessive and persistent failure together with adverse concomitant emotional arousal may lead to attentional and behavioral disturbances. In the case of overly active and disruptive puppies, excessive frustration and anxiety may adversely affect their ability to adjust effectively. Structured play and ICT provide the puppy with events and activities that are highly predictable and controllable, giving it beneficial opportunities to succeed and to obtain the emotional benefits associated with success (e.g., elation). Nothing more consistently promotes enhanced well-being and contentment than repeated success with periodic surprises (positive prediction error).

Bond Considerations

The concept of dominance has received some criticism and revision in recent years, especially as it regards the human-dog relationship (see *Concept of Dominance* in Volume 2, Chapter 8). Despite some significant limitations, the notion of social dominance remains a useful and viable construct. The positive implication of social dominance is that the owner must establish sufficient authority to limit a puppy's behavior and guide it into more appropriate directions. Most disruptive and socially competitive puppies are in search of a leader and a relationship based on cooperation and safety. In contrast, many dog owners are in search of an affectionate care-bond object. The end result of these divergent interests is often confusion, conflict, and discontentment. To succeed, the owner must defer care-bonding needs to the establishment of appropriate social limits and rule-based interaction with the puppy, whereupon care bonding naturally follows as the result of the nurturance during the training process. For its part, the puppy must learn to willingly submit to owner directives and to take pleasure from following the owner's instructions, a process that is facilitated by the presentation of affection, play, food, and other desirable things to the dog in exchange for its cooperative behavior. Social dominance does not imply, nor necessitate, rigid and hostile actions, nor does submission entail fear. Healthy dominant-subordinate relations, in fact, are characterized by a relative absence of overt aggression and fear. Although the assertion of dominance may include assertive gestures and ritualized aggressive actions, the intent of such behavior is not to evoke excessive fear. Similarly, the fawning body postures and submissive displays of the subordinate may overlap topographically with behaviors expressive of fear, but fear does not properly

characterize the motivational significance of such behavior. Both the dominant and subordinate partners appear to be influenced by affection for each other, with anger and fear being effectively constrained, thereby limiting overt aggression and other escape reactions associated with aversive emotional arousal (see *Affiliation and Social Dominance* in Volume 2, Chapter 8). Living in close social contact with each other, frequent and intense exchanges of aggression and reciprocal defensive behavior would be highly stressful and energy consuming for both the dominant dog and the subordinate. In an important sense, both the dominant dog and the subordinate are benefited by an affectionate impulse leading them to cooperate and tolerate close interaction with each other. The dominant dog's threats are tempered by increasing affection and familiarity, stimulating protective tolerance and responsibility for the group. Any fear that the subordinate may feel in response to the dominant dog's assertive displays is offset by a growing affectionate need to maintain contact in a search of social comfort and safety, a tendency facilitating a following and cooperative social role. In essence, establishing dominant-subordinate relations is a matter of enhancing mutual tolerance and affection for the sake of the greater good and benefit of the group. The subordinate's submissive displays may function as an escape/avoidance strategy aimed at evading the dominant dog's wrath, while at the same time stimulating its nurturance and protection.

Play and Leadership

Cynopraxic training promotes a balance of dominance, leadership, and nurturance in order to promote a healthy and successful human-dog bond (Figure 6.4) (see *Dynamics of Bonding: Nurturance, Dominance, and Leadership* in Chapter 4). A natural way to facilitate this process is through structured play activities. Leaders are not threatening or provocative; they are playful and fun. Just as assertive and submissive displays are modulated by affection, play activities similarly involve the exchange of behavioral sequences under the influence of affiliative motivations. Play activities early in life prepare dogs to advertise and acknowledge assertive and submissive displays in a socially constructive way, facilitating an affectionate and harmonious social existence. Protoplay activities emerge almost as soon as puppies can walk (Cairns, 1972). The ascendant emotion controlling play is joy, making playful interaction highly rewarding and conducive to the enhancement of social affection, competence, and trust.

Play is unique in that it has no apparent goal other than the perpetuation of itself, perhaps as the result of play-activated reward circuits producing elation and exuberance, even in the absence of a play companion or object. Young dogs commonly exhibit various forms of solitary play. In addition, some dogs exhibit a form of frenetic solitary activity, perhaps functioning as a compensatory release in situations providing insufficient opportunities for play. The spectacle may cause first-time dog owners to suspect that their dog has momentarily lost its mind. Dogs exhibiting such behavior appear to be possessed by a torrent of spontaneous locomotor impulses. They rush about as though careening around obstacles or fleeing from a nonexistent pursuer closing in from behind. Occasionally, a dog may appear to scramble forward faster than its body can follow, creating a hunched-up appearance as it steers wildly along its fre-

FIG. 6.4. Effective training promotes a balance of dominance, leadership, and nurturance. Dominance involves the imposition of appropriate limits on a dog's behavior in order to reduce socially intrusive excess and oppositional behavior. Leadership, on the other hand, shapes effective social behavior by means of structured play and integrated compliance training. The appetitive and social rewards used to support leadership contributes a nurturing aspect to the cynopraxic and training process.

netic path. As the playful release reaches a climax, the dog may display a wide open-mouthed smile, wedging its ears back. Meanwhile, like the baton of a drunken conductor, the tail wags excitedly one moment or, depending on the dog's passing mood and fancy, may be pressed up between its legs as though protecting it from the jaws of an imaginary pursuer. To my knowledge, a formal term has not yet been given to this kind of play behavior, but, given its solitary, spontaneous, and undirected character, perhaps the term *soliludic* would be a good choice. Soliludic activity nicely combines the Latin elements *solus* (alone) and *ludic* (spontaneous and undirected play).

Competent social play between people and dogs is expressed in two general forms: competitive and cooperative. Competitive play usually involves some element of contest (e.g., tug games and wrestling), whereas cooperative play involves sharing in the pursuit of some common activity (e.g., retrieving games). These functional aspects of play reflect the complementary dynamics facilitating harmonious group social organization and activity. Although excessive or agitational play may enhance undesirable behavior in dogs (see *Inappropriate Play and Bootleg Reinforcement* in Volume 2, Chapter 2), structured play in moderation may be highly beneficial. Tug-of-war games have been considered problematic with respect to the facilitation of dominance tensions, but little evidence supports the assumption that such games result in an increased risk of aggression in dogs not already exhibiting aggressive tendencies (Figure 6.5). Rooney and Bradshaw (2002) have attempted to test the effects of competitive play on dominance and other social behaviors. They exposed 14 golden retrievers to brief (3 minute) tug-of-war bouts involving 40 contests over 2 weeks. During the tests, the dogs were allowed to win at least two-thirds of 20 bouts and caused to lose at least two-thirds of the remaining 20 bouts. The authors found that such play had little effect on confidence levels (a measure they equated with dominance), even though the dogs reportedly became more playfully attentive, socially intrusive, and demanding as the result of repeated competitive play bouts. Observing that the win-lose outcome of tug contests had little effect on confidence levels, the authors concluded that, at least among the group of dogs tested, human-dog play is not a "major determinant of dominance relationships" (175). A number of problems with this study deserve mention. First, the assumption that brief tug-of-war contests are enough to alter canine social behavior significantly or, more specifically, that the differential effect of winning or losing such tug contests is capable of producing significant modifications of relative social dominance is highly questionable. Consequently, just because the study failed to detect a measurable effect does not necessarily mean that more lengthy or frequent bouts of tug-of-war, perhaps performed in a more agitating fashion, would not produce significant change in such behavior. In any case, the puppy is not really winning, but is being permitted to win and compelled to lose; the

FIG. 6.5. *A Tug of War* by W. J. Hardy (1891). Tug-of-war has long been a popular play activity between people and dogs. Although shunned by some trainers as being instigative of aggression, no compelling evidence links the activity with aggression problems in dogs. Competitive games can be a potent way to facilitate controlled aggression in the case of working dogs, but special agitational techniques are used in combination with ludic incentives to achieve such ends.

handler remains the locus of control throughout, that is, the play partner maintains their control status or social dominance whether the puppy wins or loses. Second, since the experimenter performing the tug contest was relatively unfamiliar to the dogs and not a member of their primary social system, such playful interaction probably did not denote the same social significance for them as it might if performed by a family member. In fact, under the parameters of the study, competitive play may be irrelevant to the dogs' social dominance interests (if such interests, as defined by the authors, exist) and, as the authors point out, may only lead the dogs to view the experimenter as a "favourable play partner" (175). Third, the experiment appears to be inadequately controlled to show that the independent variable (tug-of-war) is exclusively responsible for the behavioral effects observed. To show a causal relationship, the concurrent effects of increasing familiarity would need to be experimentally separated from the effects of tug-of-war, an experimental objective that would require the inclusion of additional control groups, a larger number of dogs, a functional and quantifiable (i.e., operational) definition of social dominance and a set of unambiguous interactive markers identifying it. Fourth, in any case, social dominance is probably a nonstarter with respect to puppy behavior and interaction with people. Puppy behavior appears more accurately described in terms of changes involving relative social subordination or dependency/attachment levels. Most puppies are happy to be obligate subordinates, exhibiting a high degree of dependency toward the owner and others, whom they seem to view as parental surrogates—not social adversaries.

In addition to learning about one another, play appears to help individuals learn to restrain immediate competitive self-interests for the sake of advantages resulting from social cooperation. To maximize the therapeutic benefits of play, it is necessary to structure play activities carefully. Dogs are responsive to a variety of play signals, including facial (play face), postural (play bow), and vocal expressions dedicated to the solicitation of play (see *Play and Aggression* in Volume 2, Chapter 8) (Rooney et al., 2001). In combination with the play face and bow, dogs may use a huffing or rapid panting sound to indicate playful intentions (Fox, 1971). Pere Bougeant (1739) long ago recognized the capacity of dogs for laughter and joy in association with play:

> Is it not evident that beasts laugh very heartily? See a couple of young puppies romping together in a field, catching, toying, and fighting one another in jest. Can all this be done without laughing? Is it essential to laughing, that it be done, as in man, by a motion of the lips and mouth, with a convulsive sound of voice? Laughing is no more than an expression of joy, and that expression is necessarily different in the different species of animals. Man laughs after his own manner, and the dog after his. No matter whether it is by a sudden bursting of the voice, or by a simple motion of the ears or tail, or by some other like expression. (196)

Recently, Simonet and colleagues (2001) made recordings of these play sounds and found that playing them back to young dogs evokes a heightened readiness to engage in play behavior. Fox reported that, the play sound (e.g., hhuh, hhuh, hhuh) was imitated, dogs became highly aroused, causing them to withdraw, bark, or solicit play. The panting sound may serve to elicit generalized arousal and, when combined with play signals, help to educe play behaviors. Repetitive sounds appear to evoke increased activity in dogs (see *Sensory Preparedness* in Volume 1, Chapter 5), a finding that is consistent with the notion that such sounds may play a role in the process of evoking play behavior.

All episodes of play should have a clearly defined beginning and end. Normally, it is best that some object be the focus of play. A tennis ball with a handle is ideal for this purpose (see *Training and Play*, Chapter 1). A small amount of an odorant (e.g., orange or orange-lemon) can be put inside the ball, perhaps helping to generalize playful associations to other contexts and thereby helping to lower play thresholds. Although structured competitive play is beneficial, highly arousing or provocative tug-of-war games, associated with growling and hard sustained biting and snapping at the toy, may result in accidental scratches and bites. Competing over a tug object produces frustration, causing the puppy to pull harder and more aggressively. Systematically raising frustration levels or

introducing an agitational element (e.g., tweaking) during bouts of competitive play can lead to an excitement overload in some dogs, perhaps precipitating an aggressive episode. This sort of behavior occurs and warrants appropriate precaution, but it is not the norm, and its occurrence may indicate the presence of significant emotional conflict, reactive dysregulation, or socialization deficits. When a trainer escalates the intensity of such behavior in conjunction with a puppy's increasing frustration and irritation, the puppy may learn to increase competitive output, becoming progressively tenacious and fearless. Under the influence of skilled training, such playful behavior can be gradually shaped into more serious and controlled aggression (e.g., police-dog training). Not fully recognizing the potential risks involved in playful competitive excesses, inexperienced dog owners may inadvertently promote excessive competitiveness in predisposed puppies. Despite the risks when improperly performed, tug games appear to provide a constructive outlet for competitive play, as stressed by Borchelt (1984):

> Although most puppies do growl during these games, it is a "play-growl" of quite different tone, intensity and significance than growls exhibited in an aggressive context. Conducted properly, the tug of war game will exhaust play behaviour and teach the puppy that mouthing and biting occur only with the toy in its mouth. Moreover, the interaction with the puppy (holding and pulling on the toy) eventually can be presented in brief bursts such that play is used to reward short durations of quiet, non-play behaviour. (172)

Enhancing the Leader-Follower Bond

Among young puppies, social relations and interactive boundaries are only loosely defined, exhibiting significant fluctuation and instability. As a result, hierarchical social distance between littermates may be weakly developed or vague, perhaps explaining the high levels of playful competitive interaction that typically occurs between them. The quality of early social competition appears to exercise a pronounced influence on how a puppy will later interact with people and other dogs after it is homed. As a consequence of early socialization experiences, most puppies come into the home with a set of established biases about what to expect from contact with others as well as possessing a well-practiced repertoire of playful competitive skills. The young dog does not naturally know or respect human social boundaries, but must learn directly from its interaction with people what is, and what is not, appropriate. The mother has given her puppies a solid foundation for inculcating such social learning, but everything depends on the owner taking over this canine educational process.

Upon coming into the home, the puppy may show a definite inclination to continue behavior that it has already learned and to refine its competitive skills further, often at the expense of the hands and clothing of family members. Since playful competitive activities appear to be highly reinforcing for puppies, it is of utmost importance that such behavior be blocked and redirected into more appropriate outlets. This is sometimes a hard-won step in a puppy's social education, but one that most certainly must be taken in order to ensure that the puppy becomes a welcome member of the family. To achieve this goal, the owner must provide the puppy with structured guidance, limit-setting directives, and positive instruction. Unfortunately, this process of social learning and adaptation is one that is commonly neglected, either as the result of misunderstanding or poor advice. Instead of becoming the object of affection and deference, the owner, failing to achieve the necessary social distance to become a leader, becomes a target of inappropriate social excesses. Owner contact needs, permissiveness, and tolerance provide an environment in which competitive behavior becomes exaggerated and progressively more difficult to control. In relatively gentle breeds (and individuals), the detrimental effects of such interaction may be limited to disrupting the leader-follower bond and impeding the acquisition of basic lessons needed to adapt harmoniously to life with people. However, in the case of more aggressive breeds and individuals, failure to exercise appropriate discipline, impose social distance, and assert leadership prerogatives may produce long-lasting and potentially serious consequences.

Establishing leadership does not entail or imply the use of hostile or provocative actions to dominate a puppy. Stimulation of excessive fear is counterproductive and destructive of social cooperation and trust. Scott (1992b) has argued that physical punishment is inappropriate for discouraging excessive competitive behavior in puppies. Instead of applying painful methods of physical punishment, he suggests that better inhibitory effects can be attained by the surprisingly simple means of restraint:

> In some of our experiments with dogs, we reared hundreds of puppies without using punishment, and were never attacked by them. What we did was to pick up the puppies almost daily, for various reasons. This began long before they were able to resist or fight, and they formed strong habits of relaxing peacefully in our arms. We could even break up a dogfight by picking up one or both of the contestants. (15)

Although submission and fear share some motivational overlap, they possess very different functional characteristics. In general, fear represents an adverse side effect of inappropriate techniques used to inculcate a subordinate attitude.

Good Things Must Be Earned

Among the most important lessons for oppositional puppies to learn are that *good things are better when earned* and, secondly, that *waiting is a canine virtue*. These central themes of puppy training entail that the desirable outcomes be made contingent on compromise and cooperation, in accordance with what Voith calls the Nothing In Life Is Free (NILIF) program (Voith, personal communication, 2002). The strategy includes controlling access to food, affection, exercise, opportunities for outings, play, and chew toys—in short, everything that a puppy may want can be used to shape more cooperative behavior. This training activity is integrated into everyday situations by exchanging rewards for compliance—thus the term *integrated compliance training* (ICT). Puppies should be trained from an early age to follow instructions and to develop a habit of compliant waiting, training that helps to form a solid foundation of impulse control for all future training and socialization efforts. In addition, young puppies can easily master basic obedience skills, such as walking on leash, sit, down, come, and stay. Training puppies to obey with positive incentives involving affection, play, and encouragement is much more effective and enjoyable for both the puppy and the owner than using force to compel cooperation and compliance.

Establishing a strong orienting response is an important first step. A squeaker is used to capture the puppy's attention and, just as it orients toward the trainer, a click is delivered and immediately followed by a flick of the right hand to the side. As the puppy approaches the bridge, "Good" is delivered and the hand is opened for the puppy to take the treat. This pattern is repeated again and again until the orienting response is strongly conditioned. The next phase involves pairing the squeak, orienting response, click, and "Good" with positive prediction error, whereby the size, type, and timing of the reward are varied to produce surprise. In addition, the squeaker sound is varied by squeezing it sometimes once or twice, sometimes firmly, sometimes softly, sometimes very briefly, and so forth. Sometimes, instead of having the puppy come back to the hand, the trainer tosses the treat to the puppy just as it turns its head. At other times, the treat is concealed under the last two fingers so that when the first two fingers open the hand appears empty, but then, just at the moment the puppy appears to recognize the discrepancy, the trainer says "Good" and opens the last two fingers to reveal the treat. Orienting and bridge training provide an anchor from which an almost limitless set of modules, routines, and patterns of tremendous variety and complexity can be trained.

DIFFICULT PUPPIES: ESTABLISHING THE TRAINING SPACE

Establishing a training space is achieved by setting limits on three common disruptive excesses: jumping, biting, and pulling (see *The Training Space* in Chapter 1). In addition

to limiting disruptive aspects of a puppy's behavior, this process results in the development of a beneficial degree of social distance between the owner and the puppy. Social distance emerges in the context of dyadic interaction and the formalization of social *roles* and *relations*. These social roles and relations are organized in accordance with various *rules* that govern the budgeted delivery of rewards and punishment. Intrusive excesses, such as biting and jumping up, behaviorally reflect a lack of organized social distance between the owner and the puppy—a necessary precondition for organizing rule-based roles and relations. Without the formation of appropriate social distance, a dog is prone to exhibit reactive social adjustments and develop an overly dependent attachment—not a harmonious relationship. On the other hand, extrusive excesses, such as pulling on the leash, strain the training space outwardly in the direction of attractive environmental stimuli competing for the puppy's attention and causing it to become distracted and pull. Fixing regulatory limits around intrusive and extrusive excesses is an essential step toward effective reward-based training efforts.

Pulling

A functional training space involving difficult puppies begins by training them to walk on a long line and a leash (see *Walking on Leash* in Chapter 1). Countless problems can be avoided or resolved by training puppies to actively follow the prompting of a leash. Pulling on the leash is inconsistent with the development of a healthy leader-follower bond and is productive of significant frustration and oppositional behavior. Pulling on walks has been associated with aggression problems in dogs (Podberscek and Serpell, 1997). Essentially, the leash is a physical representation or reification of the trainer's will. Instead of walking in a controlled and deferential manner, a pulling puppy is in continuous competition and conflict (opposition) with the owner for control. In contrast, a puppy that learns to walk with, rather than against, the owner appears to derive social bonding benefits from the exercise of increased impulse control. The reward-based techniques used to encourage slack-leash walking or controlled walking serve to enhance the leader-follower bond, improve attention, and increase impulse-control abilities. The puppy first learns to walk on a long line in the context of attention and recall training. A well-conditioned squeaker or similar attention-controlling stimuli can be used to override most distractions. Using a squeaker and clicker can rapidly help to shape the habit of walking on leash without pulling. For most puppies, a flat collar and leash is adequate, whereas, in the case of more assertive puppies that pull hard, a fixed-action halter can be very helpful. The clamping action of muzzling halters seems to produce unnecessary distress in puppies, and since there is no real need for such clamping action, a nonclamping halter is better suited for puppy-training purposes. Gradually, by limiting pulling and by selectively reinforcing appropriate walking behaviors, the halter control is eliminated. As with crate training, the goal of halter training is to get rid of the head halter as soon as possible.

Body Boundary

In practice, the training space is defined by the establishment of limits around biting and mouthing, jumping up, and pulling on the leash. Social limits are first set around the trainer's body. Both puppies and dogs should learn not to jump onto the trainer's lap, back, or arms, or leap at the face. As the body boundary is respected, puppies can then be trained to jump up on signal, as a reward for waiting and respecting the limit being set on the behavior. During social boundary training, puppies should be kept on leash. With the handler sitting cross-legged on the floor, any effort by the puppy to come up on the trainer's lap is countered with "off!" and a forearm block, as needed to prevent access to the lap. The force of the action is determined by need, with some puppies requiring very little direction and others requiring a more assertive impression. Gradually, the prompting action is delayed and faded to a slight movement of the fore-

arm as a warning, but the action may need to be reinstated if the puppy fails to respond to the faded prompt.

At the earliest sign of deference, the puppy is comforted and reassured with petting, gentle words, and food rewards (Figure 6.6). In the case of puppies showing a strong proclivity for biting on hands and clothing, a treat is held in a closed hand. As the puppy presses its nose against or licks the hand, the owner says "Good" in an affectionate tone and gives the treat to the puppy. This procedure is repeated with both right and left hands. Next, the puppy is encouraged to play tug with a tennis ball attached to a hand loop or other soft toys appropriate to the puppy's size and interest. After a brief tug game, a treat is offered to the puppy in exchange for the ball. When the ball is released, it is immediately thrown a few feet away and the puppy encouraged to retrieve it. As the puppy turns with the ball in its mouth, the owner should

FIG. 6.6 Feeding by hand and ball play.

flick the closed right hand (containing a food reward) to the side to attract the puppy's attention. The puppy is encouraged to hurry back and to release the ball ("Out") in exchange for a treat. Again, the puppy is encouraged to play tug, release the ball, retrieve it, and is rewarded with a treat concealed in a closed hand. Once the pattern is well established, vocal signals can be presented at appropriate points in the process to help bring the pattern under stimulus control. For example, just before the puppy turns, the handler should say its name and smooch; as the puppy moves toward the trainer, "Come" is spoken in a friendly tone and, finally, the trainer says "Good" just before giving the treat to the eager retriever.

At some point, the ball is left on the trainer's lap. If the puppy attempts to jump up to take it without invitation, the trainer asserts "Off," followed by a delayed slight forearm movement or thrust prompt, as needed to defend the boundary. If the puppy defers, it is given a treat by hand and the ball play is resumed; if not, appropriate blocking actions are repeated until the puppy actively defers to the body boundary again. Once the puppy shows a stable deference to the limit set around the lap, it can be given permission to come up by the trainer snapping thumbs and gesturing upwardly toward his or her body and saying "Hup" as the puppy is lifted onto the lap. Permission to get up on the lap is periodically given as a special reward. While on the lap, the puppy is petted, massaged, and vocally reassured. If the puppy begins to mouth, it is immediately pushed off and is let up again only after deferring to the biting rule. Such puppies can often be calmed by petting under the neck and on the chest between the front legs.

Jumping Up

In addition to controlling the body boundary while sitting on the floor, puppies should also learn to refrain from jumping up while the trainer is standing upright. Since jumping up is normal and friendly behavior that is acceptable under certain circumstances, the goal of training is not to suppress jumping up, but rather to bring the jumping response under

stimulus control, that is, establish a rule for its occurrence in the context of cooperative relations with the trainer. Puppies should be trained to jump up on signal (e.g., "Hup," with a thumb snap and upward movement of the hands) and to get off on signal (e.g., "Off," followed by downward movement of the hands). Puppies that jump up excessively can be trained with a differential reinforcement of other behavior (DRO) procedure, combined with a response-blocking procedure (e.g., stepping on the leash) and TO (see *Jumping Up* in Chapter 5). An alternative DRO training procedure involves delivering a click and treat after some variable but brief period (e.g., 2, 5, 3, 7, 2, and 3 seconds) and then occasionally dropping several small treats on the floor as a surprise. The treats should be very tiny and blend in with the flooring, thereby making it difficult for the puppy to find them. After dropping the treats, the trainer then helps the puppy locate them by pointing over the spots and making smooch sounds. Occasionally, as the puppy reaches the spot, the trainer might drop a choice treat, as though by accident, from the pointing hand to the floor. Dogs appear to have evolved an uncanny capacity to exploit our oversights, foibles, and clumsy moments, appearing to derive great pleasure when they do so successfully. The puppy is next trained to orient and make eye contact in response to its name, smooch, and click.

Once the foregoing introductory phase of training is carried out, the trainer should set the situation up in a way that the puppy might be tempted to jump up, but just as it prepares to do so, the trainer says "Off" in a firm buy quiet tone of voice. The trainer then abruptly glances to the side and tosses a treat to the floor in an exaggerated manner and then points until the puppy finds it. Next, the puppy is challenged to jump up with the challenge-dare "Do you want!" followed by a tap on the thigh or chest. But before the puppy has a chance to decide, the trainer says “Good” and tosses a treat to the side in the manner just described. Keeping the puppy on leash and stepping on the leash, as needed, in anticipation of the puppy jumping up can help to make this lesson easier to learn. For overly active and intrusive puppies, this procedure trains a habit of moving away from guests in response to the pointing signal and is good preliminary training for the go-lie-down exercise.

Mouthing and Biting

Like jumping up, puppy biting and mouthing on hands and clothing are usually playful social behaviors that have become excessive, often as a result of inappropriate control efforts or inadvertent reinforcement. Whenever possible, the best strategy is to shape gradually an acceptable playful outlet while simultaneously discouraging biting with means appropriate to the puppy's temperament and responsiveness to training. Although most puppies can rapidly learn to limit their tugging and biting to play objects, some may exhibit a persistent preference for biting on hands and clothing. Setting the lap and body boundary as previously described is a constructive first step toward controlling this common nuisance behavior. By establishing a body boundary, the owner can simply withdraw the hands to the safety of his or her lap, thereby setting up a response cost contingency to further discourage mouthing or biting. Also, various reward-based training procedures can be used to cause puppies to emit behavior incompatible with mouthing and biting. Puppies showing a strong oral avidity should be transitionally trained to interact with the owner via a toy (e.g., a ball or soft toy). The toy provides a triangulated object relation by which some of the puppy's playful social competitiveness and energy can be deflected or reorganized. In a sense, dog toys serve a similar function as transitional objects, as teddy bears do for young children. Dogs appear to treat toys as though they are partially animated, becoming joy-producing prey or objects of competition, especially as the result of interactive play with the trainer. Interactive object play appears to stimulate canine fantasy, mediating an object relation with the dog that the trainer can connect up with and guide to gradually transition the puppy toward a more realistic and rule-based relationship.

For some puppies, a startling tone of voice or expression of discomfort followed by the

introduction of some other activity (e.g., prompting the puppy to play a tug-and-fetch game) may be sufficient to control mouthing and biting excesses, whereas, in the case of more aggressive and competitive puppies, more assertive means may be necessary to discourage the activity. An active-control line can be used to turn the puppy away (TO) when it becomes overly intrusive and bites at the hands. As the puppy calms down, it can be called by name and tossed a ball to retrieve before being called back to engage in a bout of tug. Again, the amount of force used during such training is determined by a puppy's response and need. Often a reprimand ("Enough") or gentle prompt on the control line is sufficient to interrupt the activity and to turn the puppy's attention toward a more appropriate outlet (e.g., ball play). The prompting action should be sufficient to turn the puppy away, but need not be overly threatening or fear eliciting. Following such events, the trainer should challenge the puppy with the back of the right hand, held just in front of its nose, and in a daring and clipped tone state firmly "Do you want!" At such times, the puppy should yield an appeasement lick or avert its head, at which point the handler should reassure it with affectionate petting, gentle talk, and a food reward. Allowing the puppy to gnaw on a biscuit held so that only a small portion of it can be taken at a time provides a source of sustained reward, during which time the trainer can pet the puppy under its neck and chest. Subsequently, the challenge-dare can be used preemptively whenever there is an increased likelihood that the puppy is about to mouth or bite. The challenge can also be used to interrupt low-grade mouthing efforts. Whenever practical, mouthing on hands is best handled by reducing it gradually, granting the puppy some playful and affectionate mouthing allowance, so long as it shows a reliable willingness to defer when required to do so and it properly respects limits with regard to bite inhibition.

In the case of persistent or highly competitive puppies that escalate their efforts when thwarted, repeated 15- to 30-second TOs are used to reduce arousal and to discourage the behavior (see *Using Time-out to Modify Behavior* in Volume 1, Chapter 8). At the conclusion of each TO, the puppy is returned to the situation, prompted to sit, challenged, and reinforced with affectionate petting and other rewards, such as a tug-and-fetch game, when it defers. However, if the puppy attempts to bite instead, the trainer says "Enough, Time-out," and the TO procedure is repeated again and again (e.g., three to four times), until a de-arousal effect is observed. Rhythmic stroking on the neck and underside of the chest can also be helpful to induce a calming effect in many puppies. In some cases, a DRO procedure can be extremely useful as a means to moderate arousal levels. As control is established, a tug-and-fetch game can be offered as an alternative outlet for competitive play. In other puppies, an orienting response to a squeaker is formed in the manner previously discussed (see *Good Things Must Be Earned*). Once the squeaker is conditioned as a strong orienting stimulus, the squeaker can be used to interrupt mouthing. Just as the puppy stops, a click is delivered and a treat is given from a closed hand. To accomplish this training, the squeaker is held in the left hand under the last two fingers while the clicker is held between the first two fingers and the thumb. The back of the right hand is presented to the puppy and, as it orients, a click and treat is delivered. This pattern is repeated, and the puppy gradually learns to orient on the hand as a targeting stimulus. After taking food rewards, the trainer should pet and rub the puppy under its neck and chest. Repeated rewards involving food and petting appear to recruit a calming effect, perhaps via the conditioned and unconditioned release of oxytocin (see *Origin of Reactive versus Adaptive Coping Styles* in Chapter 4). As the puppy learns to follow the hand, it can be held over the puppy's head to prompt it to sit, moved downward to cause it to lie down, and so forth. The puppy is trained to sit, lie down, sit from the down, and stand from the sit, with vocal signals, bridge, and treat delivered at each step. If at any point the puppy attempts to mouth, the squeaker is used (sometimes softly and sometimes with a sharp squeeze) to interrupt the behavior, whereupon the trainer clicks, rewards the puppy, and initiates another series of basic training exercises or a tug-and-fetch game.

A collar control-and-thrust procedure can also be used in some persistent cases where less coercive methods have failed. The collar control is established by taking the leash at about 10 inches from the collar. The leash is wrapped once over the thumb and then gripped by closing the last two fingers of the left hand over it. Next, as the puppy continues to bite, the collar is abruptly taken with the right hand at approximately 4 o'clock and held with all four fingers closed around it. The left hand is then opened (except for the last two fingers holding the leash) and placed securely behind the puppy's head. Care should be taken not to grab the puppy's skin or fur while setting the collar control. With the collar control in place, the trainer makes direct eye contact and delivers a barklike reprimand "Enough," followed by a forward thrusting action. The thrusting action is delivered by tightening and immediately relaxing the muscles of the hands, arms, shoulders in an abrupt and concerted movement. If the puppy defers, it is then challenged to produce a submission response (e.g., appeasement lick or head-averting action)—behavior that is immediately followed by affectionate reassurance and petting. If the puppy escalates in response to the collar-control thrust, the control is released and the puppy is abruptly hauled off to TO. As the puppy defers and accepts petting without biting, the collar control is taken up periodically; however, instead of following it with a direct stare and assertive forward thrust, it is paired with affectionate eye contact, a smile, and rhythmic massage around the jaw muscles with the thumbs. In addition to reinforcing submissive behavior, affectionate petting and gentle talk can help to reassure the puppy that the handler remains a source of comfort and safety. At this juncture, a cycle of PFR training should be initiated. PFR training promotes relaxation and subordination to manual control (Figure 6.7) (see Appendix C).

Although hard mouthing and biting should be discouraged, the puppy should be gradually taught to mouth and bite on the hands in more gentle ways, by using the vocal signal "Gentle" to modulate the pressure of biting actions. Also, the puppy should be frequently encouraged to lick the trainer's cheek, or ear, with appropriate care taken and common sense exercised at all times to avoid taking unnecessary risks in this regard with puppies exhibiting unusually strong or aggressive mouthing and biting

FIG. 6.7 Puppy massage.

proclivities. Any nipping at the face should be promptly and firmly discouraged, while at the same times rewarding licking with sweet talk and an affectionate caress. Most puppies, even the most persistent and excitable ones, show a clear differentiation of behavior toward the hands and face. At one moment, they can be vigorously mouthing on hands, but immediately stop as the cheek is offered to them to kiss, whereupon they often lick or nibble at the ear, as well. Puppies that lack this apparent species-typical differentiation of biting and licking behavior—that is, biting equally on the hands and face—should receive intensive early training. Another developmental marker that should trigger concern and initiate appropriate training and socialization efforts is an active unwillingness to establish and to briefly hold eye contact (see *Social Engagement and Attunement* in Chapter 8). The presence of such behavior may represent a significant adjustment marker and should be the topic of future study.

Olfactory Conditioning and Excessive Biting

The introduction of an exciting food odor by a squeeze bulb can be useful in the control of some mouthing excesses that occur in association heightened emotional arousal. The activation of the olfactory system with the smell of an exciting food appears to exert a modulatory effect over the amygdala and hypothalamus, while strongly stimulating the ventral tegmental area, a brain area believed to play a prominent role in mediating reward. A strong-smelling cheese such as Romano or Parmesan can be cut into fine slivers and put inside a baby aspirator bulb. Sniffing the odor may interrupt the unwanted behavior briefly as well as perform an establishing-operation function, making the puppy more likely to show behavior previously conditioned with food reinforcement. For a hungry animal, the opportunity to smell food represents a significant incentive and potential source of reinforcement. With regard to the potency of appetitive olfactory stimuli, Long and Tapp (1967) found that hungry rats exhibit a pronounced increase in responding when reinforced with the smell of a familiar food:

> The response rates elicited by the deprived animals for the odor of powdered food were quite high in comparison with most other rewards. To the authors' knowledge, no other rewarding events, except electrical stimulation of the brain and escape from foot shock, have been shown to be such effective reinforcers when delivered on a similar schedule. (18)

In other cases, a novel odor can be delivered from a squeaker bulb or modified carbon dioxide (CO_2) pump. Orange and lavender appear to exert mild focusing and calmative influences on many puppies; chamomile, ylang-ylang, and sandalwood also appear to be useful, but adequate research is lacking. The fragrant odor appears to produce an abrupt, if only temporary, modulation of competitive tone, sometimes producing a rather dramatic effect when presented together with the squeaker or modified CO_2 pump (see *Olfactory Conditioning*). Olfactory control appears to work better when it is delivered in the form of repeated discrete odor puffs rather than as a continuous background odor. In addition to odors that appear to exert transient focusing and calming effects, odors can be used to mediate a conditioned inhibitory effect. A conditioned inhibitory odor is established by pairing a dilute odor (e.g. citronella-eucalyptus or eucalyptus-cedarwood) with the hissing sound of a modified CO_2 pump. The selected odor is diluted 1:30-50, and a small amount of it is dabbed on a cotton wad packed gently inside the base of a inflator needle that has had the needle removed (see *Compressed Air* in Chapter 2). The scented oil is blown out of the cotton into a tissue, leaving the cotton scented but dry.

The conditioning procedure is carried out by carefully squeezing the pump lever to release an inaudible or barely audible airflow, concealed from the puppy's view and directed toward the floor—not toward the puppy. The scented airflow is continued for approximately 2 to 3 seconds before a half-second puff/hiss of compressed air is delivered to interrupt mouthing (Figure 6.8). The startle used for such training can be very effective when delivered at relatively low levels of stimulation. The puppy is immediately challenged with the back of the hand, "Do you want!" If the puppy averts its head, the response is bridged and rewarded; whereas, if the puppy fails to

defer, the conditioned odor is presented again via a squeaker bulb (squeaker valve removed). If the puppy continues to mouth, a second conditioning event is delivered using a hiss/spritz level of compressed-air startle, followed by the same challenge-dare procedure. Once the puppy defers, the behavior is rewarded, and the puppy is brought up on the trainer's lap. If the puppy begins to bite or mouth while on the trainer's lap, the conditioned odor is delivered from a squeaker bulb, and it is pushed away. The challenge-dare procedure is performed and, if the puppy defers, it is rewarded; if not, the odor is delivered from the squeaker bulb, and the puppy is rushed off to TO, followed by training activities, as described previously. A crumpled tissue scented with the conditioned odor can be placed in the TO room in advance to further integrate the significance of the odor as an inhibitory signal. Once the conditioned odor is established, it can be used to produce a

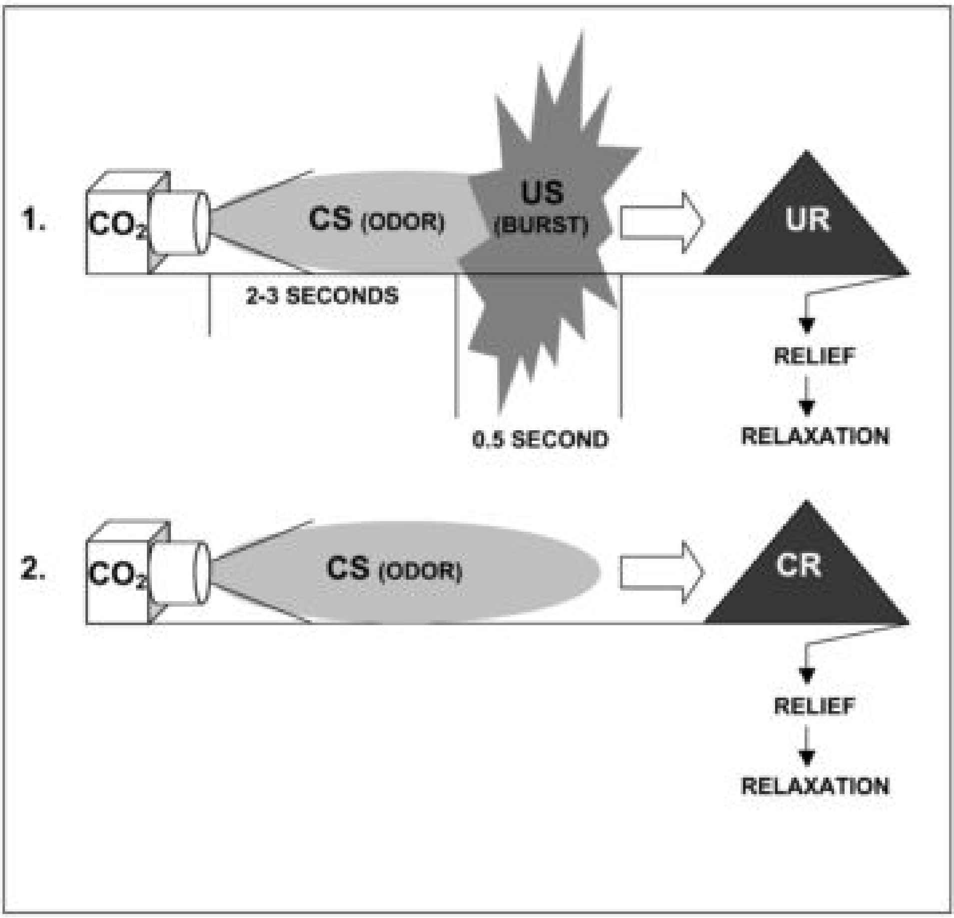

FIG. 6.8. Classical conditioning of odor and air burst. Odors are highly prepared for both appetitive and aversive classical conditioning in dogs. In cases involving persistent biting excesses not responsive to other training efforts, an olfactory conditioning procedure can be highly effective as a means to interrupt such behavior. After one or two conditioning bursts, the odor delivered at a low pressure or from a squeaker bulb (without the squeak mechanism) may cause a puppy to become more responsive to other control efforts. US, unconditioned stimulus; UR, unconditioned response; CS, conditioned stimulus; and CR, conditioned response.

direct inhibitory effect (Otto et al., 1997) or to potentiate other startle techniques (Paschall and Davis, 2002).

POSTURE-FACILITATED RELAXATION

Before coming into the home, the average puppy is exposed to a tremendous amount of competitive interaction with littermates, somatically attuning and sensitizing it to respond to tactile stimulation and manual control with increased arousal, excitement, and playful competitive behavior. In addition, the puppy may be accustomed to a high level of social stimulation no longer available to it, thereby triggering unwelcome attention-seeking excesses and intrusive competitive behavior. The owner may be confused and frustrated by the puppy's incessant search for stimulation and its prodigious appetite for competitive play, possibly leading to improper disciplinary practices, excessive crate confinement, and other practices inimical to healthy socialization and habituation. There is no justification for slapping or spanking an overly competitive or aggressive puppy, especially since such actions may only cause the puppy to retaliate with even more vigorous aggressive behavior or become progressively insular and avoidant. Threatening dominance procedures wherein a puppy is flipped on its back and pinned there against its fearful or angry protests should also be avoided unless necessitated by extraordinary circumstances requiring such restraint. Although occasional mild to moderate assertions of manual control may be expedient to avert an escalation of aggressive tensions, excessively forceful or threatening handling does little to inhibit aggressive behavior constructively. Such puppies should be provided with appropriate play and exercise, daily reward-based training, and routine limits set on inappropriate behavior via TO and response-blocking procedures. In addition, competitive and stimulation-seeking puppies should be exposed to graduated relaxation exercises aimed at reducing agitation and modulating competitive tensions. Instead of relying on excessively forceful or threatening tactics, submissive behavior can be gently and efficiently facilitated through graduated posture control and relaxation training, a process known as PFR training. When properly and routinely performed, PFR training produces several benefits (see *Basic Guidelines and PFR Techniques* in Appendix C):

1. Facilitates bonding process
2. Enhances trainability
3. Exerts beneficial counterconditioning effects
4. Promotes affection, cooperation, and trust

Taction and Posture-facilitated Relaxation

Tuber (1986) has emphasized the value of massage for promoting calmness and relaxation in dogs, advising that massage and training dogs to relax should be just as important as other training activities. Petting and massage have long been recognized as exerting significant effects on canine cardiovascular activity indicative of reduced sympathetic arousal (see *Effect of Person* in Volume 1, Chapter 9). Petting provides a potent source of reward for many dogs. Kostarczyk and Fonberg (1982) found that dogs that respond to petting as a reward exhibit cardiac deceleration while being petted, followed by rapid acceleration when petting is discontinued. The experimenters report that dogs failing to respond to petting as a reward exhibited cardiac acceleration when petted (Figure 6.9). These observations suggest the possibility that heart-rate changes in response to petting may provide useful diagnostic markers pertaining to contact aversion and proneness to irritability as the result of tactile stimulation. In the case of dogs that are responsive to petting as a reward, petting may induce sympathetic dearousal and cardiac deceleration via the recruitment of an antistress response (see *Oxytocin-opioidergic Hypothesis*).

Odendaal (1999 and 2000) has reported that close social interaction between people and dogs results in a cascade of neurobiological events that facilitate enhanced attachment and comfort. Close social contact and petting produce an elevation of circulating neuropeptides (ß-endorphin, oxytocin, and prolactin) and other neurochemicals believed to mediate pleasure (e.g. phenylethylamine), affiliative emotions, and social attachment. Oxytocin is

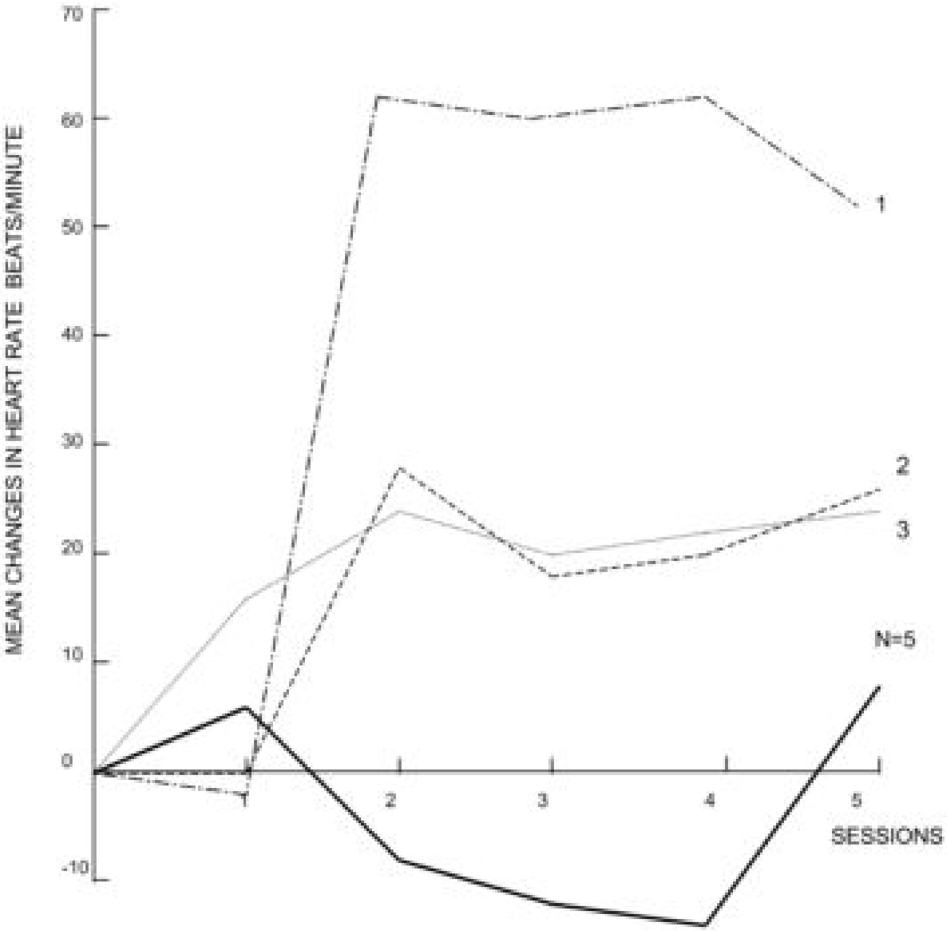

FIG. 6.9. When petting is effective as an instrumental reward, it produces a deceleration effect on heart rate. Dogs that do not respond to petting as a reward exhibit an opposite response. When petted, such dogs may exhibit pronounced heart-rate acceleration. The solid line shows the mean heart-rate changes calculated for five dogs that were responsive to petting. Broken lines 1, 2, and 3 indicate the acceleration effects of petting exhibited by three dogs not responsive to petting.

believed to actively mediate social bonding and to exert pronounced cardiovascular changes and antistress effects (Uvnäs-Moberg, 1998b), while exerting a potent diminutional effect over irritability (Lund et al., 2002) and aggression (Panksepp, 1998), "reducing all forms of aggression that have been studied" (257).

Hennessy and colleagues (1998) have reported that it is not just petting, but the way in which petting is done, that yields the best stress-reducing effects. They found that petting consisting of long, firm strokes produces the strongest effect on HPA-axis activity (Figure 6.10). Whereas light touch tends to increase arousal (e.g., tickling effect) or irritation, firm and continuous touch appears to produce a calming effect. Grandin (1992) has noted that deep-touch pressure (massage and firm petting) appears to alleviate the touch aversion exhibited by many autistic persons. Grandin, an autistic person, developed a "squeeze machine" to deliver continuous pressure over large areas of the body. She claims that the machine produces benefits, partly because one cannot pull away from it

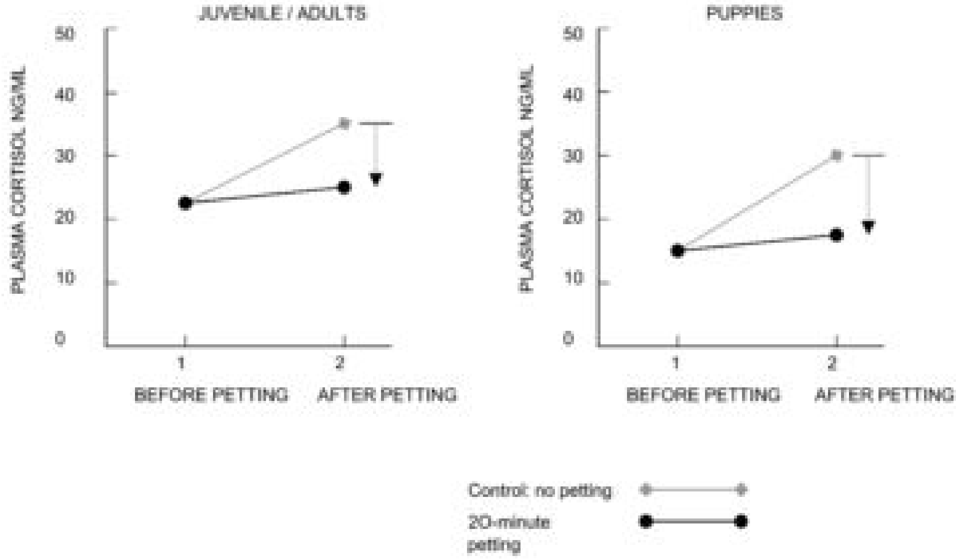

FIG. 6.10. Effect of petting on stress response to venipuncture. Petting involving firm, long, and slow strokes helps to restrain physiological stress when taking blood. Both control and petted groups had blood taken at point 1. Controls were returned to their kennels, while the other received 20 minutes of petting. Adapted from Hennessy et al. (1998).

(response prevention), making a previously aversive experience a more enjoyable one. In addition to becoming less aggressive and tense, she reported becoming more receptive of human touch and gentler in her own touching contacts with others, including a pet cat:

> Using the machine enabled me to learn to tolerate being touched by another person.... It made me feel less aggressive and less tense. Soon I noticed a change in our cat's reaction to me. The cat, who used to run away from me now would stay with me, because I had learned to caress him with a gentler touch. I had to be comforted before I could give comfort to the cat. (66)

Field (1995) found that premature babies given tactile stimulation consisting of light stroking failed to gain weight, whereas babies given massage consisting of firm stroking gained weight. In addition, Field and colleagues (1996) also demonstrated that massage therapy helps to alleviate stress-related physiological and behavioral symptoms exhibited by babies born to depressed mothers. Brief massage performed twice a week for 6 weeks significantly reduced cortisol, norepinephrine, and epinephrine levels while increasing serotonin activity. These physiological changes were associated with increased contact responsiveness and sociability in the infants. Massage has been shown to reduce anxiety and symptoms of depression in child and adolescent psychiatric patients, further reinforcing the value of massage as a therapeutic modality (Field et al., 1991). Gantt (1944) observed that petting exerted a potent inhibitory effect over conditioned anxiety in severely disturbed dogs (see *Tactile Stimulation and Adaptation*).

Posture, Response Prevention, and Posture-facilitated Relaxation

Together with supplemental environmental enrichment, exercise, play, daily training activities, and guided tactile stimulation, gentle manual control and restraint efforts help modulate a puppy's social competitive and stimulation needs. The aim of manual control is to shape behavior conducive to progressive submission and relaxation. Posture communicates behavioral intention and reflects under-

lying emotional and motivation states. Body posture and emotion exert a reciprocal influence on each other via somatic feedback. Consequently, the expression and experience of emotional states necessarily involve postural and gestural changes—*there are no disembodied emotions*. The manipulation of posture through guided controls, prompts, and position shifts is associated with the controlled evocation of a variety of emotional states. Response prevention assists in this process by blocking bodily responses incompatible with submissive relaxation. In addition, manual restraint exerts a pronounced calming effect and deceleration of heart rate—an effect that is magnified by petting and massage.

Gradually, instead of evoking competitive reactivity and resistance, the puppy learns to submit to handling as a source of increased comfort and safety. Response prevention and restraint assist in this process by blocking responses incompatible with submissive affection and relaxation. During the imposition of gentle manual restraint, the puppy is exposed to mild limit-setting actions (dominance) in the presence of the counterconditioning influence of massage and vocal reassurance. Postural restraint in combination with relaxing massage helps to reduce agitation by promoting more organized and compliant responsiveness to human control and manipulation.

Most puppies actively enjoy massage and accept PFR training without incident. However, in the case of difficult puppies, depending on individual differences, one of three typical responses to gentle manual restraint and massage may occur: submissive forbearance, competitive struggle, or efforts to escape. The manual restraint at such times should be consistent and clear but not overtly intimidating or threatening. Further, the level of force used to restrain the puppy should be immediately responsive to the puppy's willingness to defer. In cases involving extreme reactivity, preliminary desensitization and instrumental shaping procedures should be used first to encourage compliance and trust. The presentation of a fragrant odor (e.g., orange, chamomile, or sandalwood) may exert a useful calming or diversionary effect. Throughout the PFR process, the puppy is reassured and comforted with relaxing massage. The operative idea is to use response prevention and the accumulative effects of relaxing massage to help the puppy accept the next level of control with minimum reactivity, thereby improving its willingness to submit and, ultimately, achieving enhanced feelings of affection, comfort, safety, and relaxation. Over the course of several cycles of PFR training, the puppy learns to accept and enjoy the systematic, highly structured, and predictable manual control efforts composing the PFR ritual, becoming progressively relaxed and compliant. PFR training can be effectively incorporated into routine care and grooming activities. All puppies should learn to accept being brushed and combed, having their eyes and ears examined and cleaned, and having their feet handled and cleaned, and submit to nail clipping and filing. Massage-induced relaxation makes these grooming chores easier to perform and less stressful for puppies and dogs.

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7

Canine Domestic Aggression

PART 1: SOCIAL COMPETITION AND AGGRESSION

INTERACTIVE CONFLICT, STRESS, AND SOCIAL DOMINANCE

Social dominance is frequently posited as a formative principle organizing social behavior. Animals living in close groups are hypothesized to regulate their social interaction and aggressive impulses in accordance with social rank and status. According to this model, the cumulative victories and defeats resulting from competition over valued resources gradually result in a hierarchy of dominant-subordinate relations. Rowell (1974), a primatologist, has criticized the social dominance hypothesis on several grounds and rejects it as a social organizing principle. Although often bordering on diatribe, her analysis offers a number of valuable insights pertaining to social relations and organization developing under the influence of stressful conditions. She argues that rigid linear dominance hierarchies primarily develop under the influence of unnatural and conflictive conditions. Rowell, arguing that subordinate animals most often initiate conflictive interaction, turns the social dominance concept on its head by positing instead a subordinance [*sic*] hierarchy. She suggests that conditions of captivity produce unnatural levels of interactive conflict and tension, increased aggression, and the dysregulation of the hypothalamic-pituitary-adrenal (HPA) system. The submission behavior of subordinates toward dominant animals is not reciprocated by affectionate tolerance (as might occur under natural conditions), but instead is met by aggressive threats and challenges. Instead of submitting and integrating friendly relations, animals living under such conditions appear to succumb gradually to stress and develop involuntary subordination strategies, thereby losing their capacity or desire to compete effectively. The long-term adverse effects of involuntary subordination have been implicated in the etiology of depression (see Gardner, 1982). As such, Rowell's subordinance hierarchy is an index of stressful reactivity and involuntary subordination, referencing an animal's ability to cope with stressful social conflict and environmental adversity with relative social rank. Under adverse conditions, animals showing a blunted response to stressful conflict (i.e., fearlessness/low cortisol) may obtain a competitive advantage over other animals exhibiting heightened emotional reactivity (i.e., fearful/high cortisol) and vulnerability to social and environmental stressors (see *Autonomic Arousal, Heart Rate, Aggression*, and *Stress, Low Cortisol, and Aggression*, in Chapter 6):

> Submissive behavior, on the other hand, can be related to hyperfunctioning of the adrenal gland in response to environmental stress, and occurs in its most extreme form in captivity. It seems that whereas adrenal responsiveness may

> be advantageous under normal conditions, the unusually high levels of stress encountered in captivity may lead to a higher-than-useful response level. Thus a rigid hierarchy may with some justification be regarded as a pathological condition of a society brought on by too high stress levels … Whereas the concept of dominance has apparently little to offer beyond its use as a shorthand description suggested above [predicting competitive outcomes], the concept of subordinance, as seen in submission hierarchies, may still provide helpful insights, especially in relating endocrine function to behavior. (Rowell, 1974:151)

According to the subordinance hypothesis, conflictive interaction initiated by subordinate group members results in varying degrees of HPA dysregulation and adrenal exhaustion, depending on each animal's ability to cope with the stress accruing as the result of repeated activation of the flight-fight system (FFS) (see *Social Competition, Cooperation, Conflict, and Resentment*). Rowell's hypothesis predicts that higher-ranking animals should show the lowest glucocorticoid levels, whereas the lower-ranking animals should show the highest glucocorticoid levels. A social organization based on individual differences with respect to their ability to cope with social stress is reminiscent of Calhoun's experiments (1962 and 1963); however, Calhoun's findings flatly contradict Rowell's assumptions concerning the functional significance of social dominance. Calhoun's research supports the necessity of a social dominance structure in order to promote social and territorial order, to facilitate physical health, and to increase reproductive fitness (see *Calhoun's Rat Universe* in Volume 2, Chapter 7). Under conditions in which social organization was based on social dominance, Calhoun found that stressful interaction and conflict were prevented or reduced (insiders), whereas under *outsider* conditions in which social behavior differentiates in accordance with each animal's ability to cope with stress, a state of social disorder and disintegration followed.

Rowell's hypothesis is probably better described in terms of involuntary subordination and mutual intolerance resulting from unfriendly exchanges between individuals operating under the socially disintegrative influences of conflictive arousal and reactive coping styles. Dominance by threat and attack and subordination by fear generates escape/avoidance behavior, aggressive reprisals, and resentment in association with the activation of the FFS and an involuntary subordination strategy (ISS). These reactive behaviors are neither dominant nor submissive but reactive coping styles operating under the influence of the FFS. Social interaction operating under the influence of the FFS tends to promote social intolerance, irritability, disintegrative discord, and hostility.

Fear-related behavior and obtrusiveness are explicitly excluded from the classical concept of subordination and submission as described by Schenkel (1967). Antagonism and fear are incompatible with the affectionate and affiliative intent of active and passive submission. Submission behavior is basically an expression of filial love and desire to achieve an integrated and harmonious relationship within the family/pack unit. Typically, aggression problems are not the result of a dog acquiring a dominant attitude toward the owner, but rather such problems most often stem from a failure of the owner to respond to the dog's submissive solicitation for dominant tolerance and care. Instead, the owner may respond to active-submission behavior with punishment by ignoring, confining, or hitting the dog, thereby prompting adjustments based on an ISS. In contrast, when the owner responds in a friendly and constructive way to active-submission behaviors, an affiliative process based on a voluntary subordination strategy (VSS) and the integration of a trust-based bond between the owner and dog is initiated. Dominance is solicited, if not elicited, by the care-seeking and begging (active submission) behavior of the subordinate. Schenkel nicely describes the nature of submission in dogs and wolves in a manner that resonates with cynopraxic objectives:

> We may conclude that submission is a contribution by the inferior to harmonic social integration on the basis of social hierarchical differentiation. It does not elicit a stereotyped automatic response. Integration asks for a contribution by the superior also, that is, tolerance. The superior's contribution may even exceed

submission in its competence to shape the social contact or relation. (325)

WOLF MODEL OF DOMINANCE AND SUBMISSION

Many problematic training strategies used to force submission by physical punishment are derived from the popular depictions of dominance and submission portrayed by Lorenz (1955). According to this view, submission results when an opponent is defeated; however, this notion appears to be relatively alien to the social organization of dogs and wolves. Mech (1999 and 2000) has strongly criticized this popular misconception of wolf social behavior and dominance. Drawing upon observations of wolves living under natural conditions, he argues that force-based concepts of social dominance are derived from the social behavior of wolves living under captive conditions. According to Mech, social dominance and submission is an integral aspect of wolf social behavior and family life. He rejects the notion of the "alpha" wolf, arguing that such an attribution is comparable to calling a human parent an alpha. Further, since wolf offspring are generally subordinate to the breeding pair, referring to the parents as alphas or the alpha pair is redundant and adds nothing informative to the picture. The term may still have descriptive value in the case of wolf relations formed within groups containing multiple families or the hierarchical relations formed by wolves living under captive conditions (Van Hooff and Wensing, 1987). The origin and meaning of social dominance in wolves is closely associated with reproduction, a division of labor, and the formation of cooperative and harmonious family relations (Mech, 1999). These cooperative relations serve to hold the family/pack unit together and are dedicated to the service of various basic survival and reproductive priorities, including the support and protection of progeny via group-coordinated hunting and defensive activities, occurring under the leadership of the alpha pair (Mech, 2000). In the wolf family/pack, reproduction and territorial defense are the prerogative of the breeding pair (Mech, 1970), further supporting the hypothesis that dominant-subordinate relations are closely tied to incentives associated with reproduction (Derix et al., 1993). The pack is usually little more than a family group, consisting of a breeding pair and progeny. As the result of parental socialization and food begging, the progeny are trained from an early age to exhibit active-submissive behavior toward the breeding pair and other adults, perhaps helping to account for the infantile characteristics of many submission displays. Although Mech rejects a rigid and "force-based dominance hierarchy" (Mech, 1999), he acknowledges that the breeding pair dominate and lead the behavior of their young (Mech, 2000).

The progeny are typically obligate subordinates with respect to the parents, upon whom they are socially and physiologically dependent. The social competition between progeny is organized from an early age onward around the control of valued resources. These sibling rights and privileges are maintained by the exchange of ritualized threat and appeasement displays and the formation of a social hierarchy that prefigures adult status relations (MacDonald, 1983 and 1987). Competition and dominance tensions (squabbles) appear mostly to involve transient situational disputes, especially involving contests over food. The reproductive and familial origin of social dominance is reflected in the reduced tendency of male and female wolves to fight with each other (Schenkel, 1967), with the male typically dominant over the female and the rest of the pack, while the female is dominant over all pack members except the male (Mech, 1999). As wolves reach sexual maturity, they eventually leave the natal group and join up with other dispersed wolves to reproduce and form new packs, thereby reducing the risk of disruptive competition within the group. Most wolves leave the family/pack before they reach 2 years of age, with virtually all of them dispersing before they turn 3 years of age (Mech, 1999).

DISPERSAL TENSIONS AND HOUSEHOLD AGGRESSION

Some forms of canine domestic aggression (CDA) may be related to the activation of dispersal-related tensions in adulthood. As previously discussed, wolves disperse between 1 and 3 years of age, a time frame that is fre-

quently cited as significant with regard to the expression CDA (Borchelt and Voith, 1996). Although the lupine dispersal instinct appears to be reduced in dogs by virtue of paedomorphosis, some dogs may express polymorphic variations that support dispersal tensions in association with the formation of overly exclusive and dependent bonds with one particular person in the household, perhaps setting the stage for persistent interactive tensions, intolerance, and a failure of affected dogs to integrate submissive and friendly relations with other family members. Hypothetically, under conditions in which dispersal and breeding activities are thwarted, social dominance, bonding, and symbolic reproductive imperatives may coalesce in novel ways, facilitating social dynamics conducive to asexual-pair bonding, thereby forming an *insider* satellite group within the family system. As a result, the dog may become increasing intolerant toward other family members and may threaten or attack them as intruding *outsiders*, thus symbolically dispersing and establishing a territorial boundary within the context of the home (e.g., a bed or the favored owner's lap). Such dogs may gradually threaten a husband or wife when he or she enters the bedroom or while getting into the bed. More rarely, the aggressor may threaten a parent who approaches or shows affection toward a child. These dogs often show exaggerated territorial behavior, becoming highly reactive and threatening toward visitors and strangers coming into the house or approaching them while in a car. Owners may be flattered by the dog's close attention, affection, and protectiveness, and may inadvertently reinforce it. These sorts of aggression problems are often surprisingly well tolerated by the household and held as something akin to an innocent idiosyncrasy, at least until someone gets seriously bitten. Frequently, it is the "protected" person who gives first blood while daring to restrain the dog during one of its aggressive episodes.

Dynamic Modal Relations and Social Dominance

Basic Concepts of Cynopraxic Training Theory

According to cynopraxic training theory, well-organized and functional prediction-control expectancies and coordinated emotional establishing operations are subject to refinement via the coding of positive and negative prediction errors (see *Basic Postulates, Units, Processes, and Mechanisms*, in Chapter 10). A prediction error occurs when a control expectancy is confirmed but in association with an unexpected result, such that the anticipated outcome turns out to be better or worse than expected. Such discrepancies between predicted outcomes and actual outcomes produce exciting or depressing cortical reward/punishment effects via an activating or suppressing effect on dopaminergic reward circuits (see *Classical Conditioning, Prediction, and Reward* in Chapter 1). Better-than-expected outcomes resulting in positive prediction error produce surprise (reward), whereas worse-than-expected outcomes resulting in negative prediction error produce disappointment (punishment). Outcomes that match prediction-control expectancies and calibrated establishing operations are verified (reinforced) and result in enhanced comfort or safety. Verified actions are referred to as *control modules*. Control modules are under the motivational influence of appetitive and emotional establishing operations calibrated to meet the anticipated needs of a dog as it acts in accordance with functional expectancies and control incentives. Control modules form routines and patterns of goal-oriented behavior within the context of adaptive modal activities. The collection of control modules, routines, and patterns of behavior formed in association with adaptive modal activity is referred to as *culture*. Control modules and routines are maintained by the gratifying and relaxing effects (somatic reward) produced by verifying prediction-control expectancies and calibrated establishing operations. These integrative learning experiences and adjustments occurring in accordance with positive and negative prediction error and verification are mediated by a complex network of comparator loci, set points, positive- and negative-feedback systems and regulatory neural networks hypothesized to operate at a preconscious level of cognitive organization. Control modules and routines that fail to produce expected outcomes result in the disconfirmation of the instrumental prediction-control expectancy and calibrated establishing

operation. Disconfirmed control modules are extinguished by means of a revised set of incompatible prediction-control expectancies and abolishing operations (see *Startle and Fear Circuits* in Chapter 3).

Adaptive Modal Strategies

Behavior operating under the influence of positive and negative prediction error is referred to as an adaptive modal strategy or coping style. There are two general adaptive modal strategies: active and passive. Active modal strategies develop in association with reward incentives resulting from positive prediction error, whereas passive modal strategies develop in association with efforts aimed at avoiding negative prediction error. Adaptive modal strategies develop in the context of organizing and refining the expression of emotional command systems. For example, active modal strategies operating in association with the seeking system include forward movement, searching, exploring, experimenting, probing, discovering, risk taking, and so forth, whereas passive modal strategies consist of stopping or backing, hesitating, waiting, delaying, ritualizing, and so forth.

Active modal strategies are supported by reward incentives associated with positive prediction error, surprise, novelty, and enhanced arousal and excitement. As such, active modal strategies operate in accordance with what Gray (1990 and 1994) refers to as the behavioral approach system (BAS). Adaptive modal strategies incorporate and organize control modules, routines, and complex patterns of behavior. However, unlike control modules, which seek rewards that calm (reduce arousal) with comfort and safety, active modal strategies are motivated to discover and produce activity that results in better-than-expected outcomes (surprise). Passive modal strategies operate in close conformity with Gray's behavioral inhibition system (BIS), showing a heightened sensitivity for startle, and signals of loss and risk (punishment).

Control modules, operating under the combined influence of active and passive adaptive modal strategies, gradually become highly refined and reliable but thereby risk losing the ability to produce prediction error and reward. Although valuable for purposes of culture building and survival, highly refined control modules are of little use for producing the excitement and surprise evoked by positive prediction error. By necessity, prediction error cannot be determined in advance; however, active modal strategies can incorporate control-module variations and novel actions to improve the likelihood of producing such error. Such modular variations and novel actions are referred to as *projects and ventures*. Ventures are distinguished from projects by the presence of an increased element of risk and potential for producing reward. As the result of the mutual and complementary influences of active and passive modal strategies, projects and ventures are gradually refined and fitted into the culture of modules, routines, and patterns of established behavior or they are extinguished. Consequently, it is not sufficient for a project merely to produce surprise in association with novelty (diverter), but the surprise must occur within a cultural context of established prediction-control expectancies; that is, it must be relevant to the existing culture and contribute to the process of adaptive optimization.

Dynamic Modal Relations, Affection, Play, and Bonding

Cynopraxic training theory postulates that prediction discrepancies between what a dog expects to occur and what in fact occurs while engaged in some purposive social activity result in emotional changes or establishing operations calibrated to optimize adaptive adjustments to the error. As such, social emotions are dependent on the formation of interactive prediction-control expectancies and interactive exchanges that result in outcomes that to some favorable or unfavorable extent mismatch or deviate from those expectations. Social exchanges that result in reciprocal emotional changes are referred to as *transactions*. Favorable transactions mediate mutual adaptations conducive to a polity of integrated social relations or, in the case of unfavorable transactions, exchanges result in mutual reactivity, antagonism, and social disintegration. For example, highly predictable and orderly social

exchanges tend to produce formal relations, roles, and rule-based rituals of limited emotional and behavioral variability that are integrated into a rigid utilitarian hierarchy. Although a utilitarian polity of rigid dominant-subordinate relations and expectations can be productive in the context of a culture of well-established modules, routines, and patterns of interaction organized to perform some specific function, such hierarchical relations are relatively inflexible to change and lack the capacity to produce transactions conducive to positive prediction error and reward in support of affectionate bonding. Social transactions that are conducive to familial or guardian relations and roles are more flexible and mediate attachment, dependency, and feelings of comfort and safety (security). However, familial relations and roles tend to become progressively formal, rule based, and problematic with respect to emergent interactive conflict and tensions involving the ownership and control of group resources and sources of reward. The interactive conflict associated with familial hierarchies results in dispersal or the production of an ISS in response to punitive transactions.

The cynopraxic polity is formed in the context of resolving interactive conflict developing in association with conflictive familial relations and roles. Typically, interactive conflicts form around antagonistic control incentives, whereby the dog's interest in obtaining some reward object or activity is at variance with the owner's efforts to establish or maintain control over the dog's seeking impulses. Such situations become conflictive as the result of punitive efforts to block or suppress the dog's reward-seeking activity, but without subsequently leading the dog to obtain sought-after gratification via a reward deferment or delay of gratification (e.g., making the dog wait) or prompting a more acceptable substitute behavior (submissive ritual) and rewarding it with an alternative object or activity that provides a similar or greater amount of reward value to the dog than the one being forbidden. The punishment of appetitive and social seeking activities performed in the absence of alternative sources of gratification appears to set the stage for the development of an ISS. Interactive conflict is gradually resolved by means of integrated compliance training (ICT), whereby forbidden activities and resources are systematically integrated as rewards for compliant behavior (see *Integrated Compliance Training*). In the process of resolving interactive conflict and tension by means of ICT, significant amounts of positive prediction error (rewarding surprise) are produced to mediate the expression of cooperative modal strategies. According to this view, competition is a necessary precondition and elemental aspect of all forms of social cooperation and happiness, that is, adaptive success. Without competition, there is no cooperation, without cooperation there is no happiness, and without happiness there is no joy. Competition is the foundation upon which a friendly relationship is built. As the result of ICT, interactive conflict is gradually resolved and replaced with interactive harmony and mutual appreciation.

With the emergence of interactive harmony, dynamic modal relations can be formed in the context of establishing affectionate and playful relations conducive to cynopraxic bonding. Dynamic modal relations consist of affectionate and playful give-and-take exchanges and creative social projects and ventures conducive to mutual reward (positive prediction error) and a joyful bond. Dynamic modal relations are liberated in the context of affectionate and playful transactions. Playful projects and ventures are an important source of variety and positive prediction error in support of friendly social relations, cooperation, and interactive harmony. Dynamic modal relations formed in association with play (reversing dominant-subordinate relations and role playing) mediate the transformation of competition into energetic, organized, and friendly cooperation. Play is an expression of freedom and represents a life symbol of adaptive success and harmonic social integration. Social play is possible only under the influence of a polity of mutually trusting relations. As such, play mediates social flexibility and cooperative-competitive dynamic modal relations and voluntary subordination strategies based on trust, mutual appreciation, interactive harmony, and joy.

Relations formed in association with affection and play cannot be forced, and they

remain free from the influence of coercion, providing a basis of interaction conducive to a VSS Insofar as affection and play are freely given, freely received, and freely reciprocated, dynamic modal relations facilitate the integration of a harmonic social bond. Dynamic modal relations are *practiced* while giving and receiving affection and while engaging in experimental role playing and the mutual expression of flexible ascendant and descendant role reversals. In contrast to dominant-subordinate relations, dynamic modal relations and roles are fluidly and playfully expressed, exchanged, and reversed, with little more objective in mind than to maintain and intensify the relationship and its capacity to support transactions conducive to heightened feelings of mutual appreciation and trust, that is, to enjoy each other. Dynamic modal interaction becomes progressively spontaneous and free, with social transactions taking on a quality of joyful anticipation arising from the mutual anticipation of positive prediction error, thereby enlivening the relationship mutual appreciation and joy.

C-type and M-type Affinity for the Flight-Fight System

A history of friendly and supportive interaction provides an affiliative buffer and physiological calming effect, whereby the shock of exceptions to the rule or the new is absorbed by a schema-consistent bias toward reward, even though the interaction might signify a momentary setback or loss (e.g., taking a bone) or threat (e.g., unexpectedly grabbing the dog) at the sensory-input level or uncertainty (e.g., meeting a visitor at the door). Well-socialized and competent dogs learn to perceive and interpret the significance of interaction in terms of spatial, temporal, social, and contextual schemata built up in association with safe and supportive interaction with family members and others. Organizing behavioral activity in accordance with flexible prediction-control expectancies offers enormous advantages, enabling the dog to prepare in advance for impending events and to optimize its adaptive efforts to predict and control significant social exchanges (see *Functional Significance of Social Signals*). The overall effect of such social interaction is the integration of relations conducive to a VSS and a trust-based bond.

However, social environments lacking order may prevent a dog from establishing a coherent system of prediction-control expectancies, thereby impeding its ability to adjust effectively. Social interaction that lacks adequate predictability and controllability may cause modal activity to become progressively perturbed and reactive. Without an orderly and coherent foundation of standard or normal expectancies, the dog is not only deprived of the calming effects (secure mood) of somatic reward and enhanced comfort and safety, it is also barred from advancing to an organization of learning and adaptation conducive to cortical reward (e.g., surprise), and freedom, that is, behavior liberated from reactive adjustments. According to this hypothesis, uncontrollable reward and punishment, that is, aversive or appetitive events occurring independently of the dog's initiative or ability to control them, gradually leads the dog to become increasingly dependent, insecure, and incompetent. Instead of depending on its own initiative and ability, the dog may rely on the owner's daily vagaries and whims to obtain gratification for its comfort and safety needs. Since a dependent dog's needs for attention, comfort, and safety inevitably exceed the owner's ability or willingness to gratify them, an inherent state of dissatisfaction develops between the owner and the dog as the result of such interaction. A dependent and reactive dog is rarely content or secure with what it gets (it is invariably too little or too late), an insecure attachment and resentment (submission with insecurity and anger) seem to present in common with such problematic relationships.

As the result of nurturance (affection and caregiving) and punishment provided on a habitually noncontingent basis, the locus of control over significant attractive and aversive events may be externalized, that is, placed outside of a dog's voluntary initiative. For such dogs, the acquisition of comfort and safety may be integrated and experienced as something that happens to them, rather than perceived as something that they control and produce for themselves. Instead of learning to control such events by proactive means, they

simply learn to receive or react to them. Just as the loss of control over aversive events is conducive to the debilitating effects of learned helplessness, the loss of control over appetitive ones can exert a similarly paralyzing effect on a dog's ability to adapt (Sonoda et al., 1991), perhaps a condition better referred to as *learned hopelessness* in the case of uncontrollable appetitive events. A persistent loss of control over significant events, whether appetitive or aversive, may render a dog progressively incompetent, emotionally undifferentiated, and straddled by a pervasive neediness (hopeless) and insecurity (helpless). Since what an overly dependent dog gets is provided or avoided on a relatively noncontingent and uncontrollable basis, it fails to obtain the confidence building and relaxing benefits of somatic (calming) and cortical (elating) reward. The inevitable uncertainty and insufficiency of such an arrangement may predictably lead to significant frustration and anxiety, perhaps helping to explain the increased irritability, intolerance, and resentment frequently shown by such dogs. Overly dependent and reactive dogs may possess a very impoverished set of control expectancies, operating primarily under a narrow range of motivations and behaviors dedicated to maintaining the dependent relationship. Lacking the ability to control significant social, appetitive, and aversive events by proactive means, such dogs may show signs of heightened vigilance for opportunities or threats and a boosted readiness to act impulsively, becoming increasingly insecure, needy, demanding, and obtrusive—characteristics of an ISS (see *Involuntary Subordination and Canine Domestic Aggression*).

In contrast to the rich and complex social schemata and organized scripting of well-adjusted and obedient dogs, overly dependent and reactive dogs appear to operate under a limited set of reactive expectancies biased with anticipatory anxiety, frustration, and a readiness to flee or confront benign threats and challenges with impulsive and disproportionate aggression or fear. Overly dependent and reactive dogs appear to be unable to integrate a trusting bond. Such dogs may become progressively insecure and intolerant of interference while engaged in comfort and safety-promoting activities (e.g., resting and eating). They may resent and react to benign handling and changes in routine or habit. Such dogs appear to exhibit a negative cognitive bias and a selective attention for signals of punishment (loss and risk) and show a reactive affinity for FFS adjustments via anxiety (fear) and frustration (anger). Instead of responding to aversive or appetitive events in a measured and calibrated way, socially incompetent and reactive dogs may evidence varying degrees of impulsivity and a reactive coping style. Psychological stressors associated with adverse social interaction, especially uncontrollable or inescapable compulsion or punishment, may cause anxiety and frustration to shift motivationally in the direction of fear and anger, becoming progressively prominent, generalized, and reactive. The persistent frustration associated with a loss of control over significant events may result in an increasing readiness for social confrontation and aggression via an affinity with the anger-arousing branch of the FFS. The increased anxious vigilance and frustrative readiness associated with the reactive coping style are hypothesized to result in chronic stress and an increased risk of developing serious adjustment problems involving impulsive adjustments, including aggression.

As the result of individual differences, prenatal or postnatal stress, abusive or neglectful rearing practices, excessive interactive conflict and disorder, and chronic stress, pathways mediating anxiety and frustration may become sensitized and lose their capacity to adaptively regulate emotional arousal. These changes result in a spectrum of predispositions, behavioral threshold modifications, and adjustment characteristics consistent with Pavlov's choleric (c type) and the melancholic (m type) typology. The vast majority of dogs exhibiting reactive coping styles show a blend of behavioral characteristics evidencing both C and M elements or showing only moderate signs of BAS and BIS dysregulation and stress-related disorder. The c-type dog is highly motivated and prone to frustration-related reactivity and aggression (frustration intolerant). C-type dogs exhibit a reduced capacity for delay of gratification and passive-avoidance learning.

M-type dogs, on the other hand, may become progressively withdrawn, socially avoidant, and fearful, often showing a lack of interest in appetitive and social rewards, and consequently may be very difficult to train with rewards. M types show an increased capacity for delay of gratification and passive-avoidance learning, but may show striking deficiencies with respect to adjustments requiring active-avoidance learning. Although both c- and m-type dogs are reactive to punishment, c types show a heightened sensitivity or *readiness* to respond actively and offensively to threats of loss and frustration, evidencing a high degree of fearlessness, whereas m types show a heightened sensitivity or *vigilance* and a tendency to respond passively and defensively to threats of harm and anxiety, evidencing a high degree of fearfulness. Both c- and m-type dogs are oriented to signals of punishments (loss of gratification or threats of harm), resulting in global learning deficits, emotional disturbances, and adverse mood changes, in association with an inability to produce and sustain a state of comfort and safety (somatic rewards) as well as a failure to produce positive prediction error and surprise (cortical reward) via integrated active and passive modal activity.

C-type and m-type dogs tend to orient and engage the environment with a reactive coping style, vigilantly and selectively scanning for signals of punishment and exhibiting a behavioral affinity for the FFS. Depending on predisposing behavioral thresholds, c-type and m-type dogs tend to differentiate with increasing aggressive irritability (c type), fearful anxiousness (m type), or both, as in the case of panic-related aggression and separation distress. Also, c-type and m-type dogs are prone to show reactive aggression and escape behavior in response to conditioned triggers, making them vulnerable to CDA and phobias, respectively. The reactive dog's preoccupation with and scanning for signals of punishment is problematic and the source of escalating anxiety, fearfulness, and relative immunity to normal counterconditioning efforts—procedures requiring a sensitivity and responsiveness toward signals of reward and a capacity to form functional prediction-control expectancies. Also, many of these m-type dogs show pronounced psychogenic anorexia that is refractory to food deprivation or the provision of highly appetizing food rewards. Finally, both c-type and m-type dogs show deficiencies with respect to their ability to initiate and sustain social play. To the extent that moderately unstable c-type and m-type dogs can be encouraged to play and to accept food and petting, a stabilization effect may be mobilized toward more adaptive coping styles.

In contrast to the reactive coping styles of c and m types, sanguine (s type) and phlegmatic (p type) dogs show distinctive adaptive coping styles. S types tend toward an active modal orientation (e.g., seeking and risk taking) with a BAS affinity, whereas m types tend toward a passive modal orientation (e.g., hesitating and risk avoidant), showing an adaptive response to anxiety and frustration. S types exhibit a selective attention and preference for signals of reward and playful modal activity. On the other hand, p types show a selective attention and preference for signals of successful avoidance, with a hesitation-sensitized affinity for the BIS (see Gray, 1990). S-type and p-type dogs may show defensive aggression and fear (attack and escape), but almost always only in response to unconditioned aversive stimuli that are otherwise uncontrollable. The vast majority of dogs incorporate a balance of s-type and p-type characteristics acquired in the process of coping and adjusting adaptively.

Filial and Sibling Dominance-Submission Relations

Dominance, leadership, and nurturing relations analogous to those exhibited by the wolf family/group appear to develop between people and dogs. The establishment of dominant-subordinate relations naturally emerges in the context of a puppy's relationship with the mother and by extension the dog owner. Puppies do not need to be made submissive but come readymade as obligate subordinates and, to the extent that they beg for nurturance (e.g., affection, food, and play), they are submissive. In contrast, the owner may fail to become a competent leader or misunderstand

the significance of the puppy's persistent and intrusive active-submission behavior, perhaps interpreting it as a defiant threat to the household's social order. Instead of embracing the puppy's enthusiasm and keen motivation and using them to shape more appropriate behavior via contingencies of reward or rules, the owner may attempt to punish them or mechanically suppress them with excessive crate confinement. As a result, the incompetent leader and the puppy may gradually become wedded to a futile ritual of confusion and conflict involving convergent but antagonistic control incentives and relations. This general scenario of involuntary subordination is an all-too-common perversion of social dominance, in which submission and subordination occur in association with interactive conflict and stress. Instead of mediating friendly and mutually calming relations in association with adaptive coping styles, the owner and the puppy may become locked into a adversarial contest of wills.

Alternatively, owners may neglect to assert competent control and limit-setting actions. As a result, the puppy may become progressively intrusive and demanding in ways consistent with sibling competitive interactions, including playful sparring, harassment, and obtrusive interference. Family members who neglect to establish competent social limits may become the object of intrusive excesses (see *Competitive Social Excesses* in Chapter 6). To build a successful relationship and bond with the dog, the trainer must be both tolerant and able to set appropriate social limits constructively, as Schenkel (1967) nicely describes in the case of wolf social behavior:

> If the superior is tolerant but fails to display his superiority, the inferior may behave obtrusively. In case the superior is not tolerant, i.e., threatens or even attacks the inferior, the latter tries to escape and defend himself and shows signs of social stress … We may conclude that submission is a contribution by the inferior to harmonic social integration on the basis of social hierarchical differentiation. It does not elicit a stereotyped automatic response. Integration asks for a contribution by the superior also, that is, tolerance. The superior's contribution may even exceed submission in its competence to shape the social contact or relation. (325)

Involuntary Subordination and Canine Domestic Aggression

Whereas the differentiation of social relations and roles associated with filial submission appears to be based on obligate subordination (social polarity, active submission, and begging), the roles and relations associated with sibling competition involve a variable history of previous competitive successes and dominance-related behavior. Sibling competition appears to be organized in accordance with prediction-control expectancies and emotional establishing operations, giving rise to emergent adaptive (s type and p type) and reactive (c type and m type) strategies for coping with social conflict and tension, including (1) a VSS (affectionate submission, playfulness, confidence, flexibility, friendly, and appeasing) and (2) an ISS (obtrusive and interfering, adversarial and rigid, and reactive anger or fear).

The involuntary subordination theory of CDA suggests that dogs are socialized and trained from an early age to accept voluntary or involuntary subordinate roles with respect to family members who are conducive to an adaptive coping style (compromise and cooperation) or reactive coping style (conflict and flight-fight reactivity) that persists throughout a dog's life cycle. As a result of competent socialization, limit setting, and reward-based training (parenting style), a generally affectionate and submissive VSS is integrated into friendly and cooperative relations with family members. However, as the result of incompetent socialization and force-based training (dominating style), a dog may adopt an ISS, showing oppositional, conflictive, and reactive flight-fight behavior toward family members. Such dogs and households may fail to integrate relations conducive to the formation of a trusting bond. The ISS expresses itself in a broad spectrum of problem behaviors occurring within the household. Over the course of a dog's development, competitive tensions and reactive triggers evoking threat or overt

aggression may develop around contested resources and privileges. As dogs reach maturity, interactive conflict and the potential for overt aggression may assume a more ominous significance, with dogs sometimes delivering serious attacks against the interference of family members (see *Filial and Sibling Dominance-Submission Relations*).

Whether aggression emerges or not in association with an ISS depends on biogenetic and ontogenetic influences, including the dog's relative excitability, behavioral thresholds controlling the activation of the FFS, and allostatic (stress) load. Allostatic load refers to the wider implications of stress, including biogenetic risk factors, early experience, lifestyle (nutrition, exercise, and play) and other quality-of-life influences, quality of social relations, and perceived control over stressors (McEwen, 2000). Too much or too little stress is problematic and potentially harmful. Dogs exposed to adverse prenatal or postnatal stress, abuse or neglect, or other sources of significant early stress may be particularly vulnerable to the disorganizing effects of psychological stress. Dogs showing heightened excitability with low anger/aggression (fight) thresholds (c type) tend toward offensive and impulsive aggression, whereas dogs showing a low fear/escape (flight) threshold combined with a medium-anger/aggression threshold (m type) are prone to show defensive and avoidance-related aggression. Excitable dogs showing low fear/escape and low anger/aggression thresholds are prone to conflict-related or panic-related aggression. Cynopraxic socialization and training conducive to a VSS exerts a protective influence against the development of household behavior problems by promoting a flirt-and-forbear coping style and consolidating an antistress, antifear, and antiaggression system, thereby offsetting adverse biogenetic and ontogenetic influences (see *Phylogenesis, Polymorphism, and Coping Styles* in Chapter 6).

Submission is mediated by establishing rights of ownership and setting limits around resources evoking seeking behavior. The valued resource or activity is then transformed into a reward by providing access to it in accordance with a rule and a submissive ritual (e.g., sit-stay), a change necessitating compromise and delay of gratification. The object of appetitive seeking is subsequently provided to the dog in exchange for cooperative behaviors in the context of leader-follower activities incompatible with intrusions upon the social limit. Positive prediction error (surprise) occurring in association with the gratification of ensuing leader-follower activities promotes the consolidation of a VSS and the acquisition of interactive modules, routines, and patterns of behavior conducive to the resolution of interactive conflict and tensions. The vast majority of dogs exhibit a balanced admixture of emergent dominant-subordinate characteristics enabling them to respond adaptively to socially competitive situations. Social competition and cooperation are intimately linked, and the dog appears to be biogenetically engineered to respond to competitive situations by expressing cooperative adjustments (VSS), if only the human companion is competent and able to confidently take the lead. Cooperative activity appears to depend on a structure of hierarchical relations emerging in association with competitive transactions and play. As a result, adaptive coping styles develop to promote affectionate submission and tolerance and mutual reliance and appreciation (tend and befriend) (see *Adaptive Coping Styles: Play, Flirt, Forbear, and Nip* in Chapter 6). Under the influence of adaptive coping styles, competitive social behavior is gradually differentiated into a complex set of cooperative and friendly dynamic modal relations, roles, and mutual expectations conducive to interactive harmony and trust.

SOCIAL DOMINANCE: DISPOSITIONAL CAUSE OR ATTRIBUTIONAL ERROR

The social dominance hypothesis is frequently appealed to in one form or another to explain CDA. Although the dominance model has value for understanding certain types and aspects of domestic aggression in dogs, the hypothesis can also be used to justify faulty interpretations and misunderstandings, based on misleading linkages between dog aggression and social dominance (see *Concept of Social Dominance* in Volume 1, Chapter 8). As a result of bias and misinformation,

attributing dispositional causes such as dominance to explain aggressive behavior is risky and prone to anthropomorphic error and the elaboration of explanatory fictions. The issues involved are complicated but deserve focused attention in advance of considering treatment protocols and procedures. Avoiding explanatory fictions is significant with respect to treatment programs because such errors adversely affect the way in which aggression problems are framed and approached, thereby influencing the selection of procedures used to address the problem. Historically, since dominance was viewed as something achieved by means of force and threats (Most, 1910/1955), the dominance hypothesis was and continues to be used in some quarters to justify inappropriate physical punishment and brutalization for the control of aggression problems. In addition to justifying inhumane methods, protocols and procedures that are based on phantom causes are doomed to produce chimerical cures. Social dominance is a significant and valid construct, but it requires careful definition and delimitation for practical use in the context of training and behavior therapy.

Dependent, Independent, and Intervening Variables

Observing and measuring behavioral changes as they occur in response to the presentation of highly controlled events or conditions is central to the experimental study of behavior. Most laboratory research involving animal behavior and learning involves a methodology in which antecedent and consequent events are rigorously defined and controlled. Behavior occurring under the influence of arranged antecedent and consequent events or conditions is referred to as *conditioned behavior*. The various controlled conditions or antecedent or consequent events are referred to as *independent variables*, whereas the observed changes in behavior that occur dependently in association with their presentation or omission are referred to as *dependent variables*. Independent variables are related to dependent variables as causes are related to effects. Many scientific theories also postulate another set of variables that, although not directly observable, are believed by inference to mediate or intervene between causes and effects. For example, in mechanical physics, the ability of one object to displace another is understood in terms of a variety of postulated intervening variables, such as gravity, mass, inertia, and momentum. No one has ever seen gravity, but the existence of gravity is inferred from the observable movements of objects and the effects they produce on the motion of other objects.

Intervening variables are often used to help explain how independent and dependent variables are related to one another, thereby rendering the relationship between them more predictable and controllable. For example, although the contingent presentation of food (independent variable) *can* increase the frequency of some target response (dependent variable), the presentation of food does not necessarily result in reinforcement; that is, the presentation of food does not necessary strengthen or increase the rate of responding. In order for food to function as reliable reinforcer, at minimum, a dog must be motivated to seek and eat food when it is presented; that is, the dog must be hungry. According to this interpretation, hunger is inferred as the intervening condition making the presentation of food more likely to result in reinforcement. Radical behaviorists reject intervening variables as being unnecessary for studying behavior. Instead of postulating hunger as an intervening variable, these researchers collect information about the animal's weight or the length of time that it has gone without eating—deprivation period. Theoretically, with the accumulation of data concerning the effects of deprivation on reinforcement, and holding all other independent variables constant, one would be able roughly to predict the probable size of the effect that reinforcement will have on the frequency of the target response based on the number of hours that the animal has been deprived of food.

Explanatory Fictions

Intervening variables such as hunger, thirst, and sleepiness are relatively harmless, providing a reasonable and useful, if not entirely reliable or scientifically framed, simplification

for understanding the motivations underlying ordinary behavior. However, the use of intervening variables to understand the causes of complex social behavior is subject to several potential sources of error, including the promulgation of explanatory fictions. Explanatory fictions occur when an intervening variable is inferred as a cause mediating some behavioral effect where in fact no such causal relationship exists. The assignment of attitudinal attributions (e.g., "the dog is stubborn"), emergent dispositional attributes (e.g., attachment and social dominance), and appeal to emotional states as mediating causes are particularly prone to error and fictionalizing. Despite the risk of error, appeal to dispositional intervening variables is common in applied settings (e.g., boredom, conflict, stress, anxiety, frustration, or dominance). Since the identification and interpretation of dispositional causes are often an important aspect of behavioral diagnosis and treatment decisions, it is of utmost importance that such causes be carefully delineated; otherwise, treatment efforts may be inefficient or ineffective. In some cases, faulty dispositional inferences and explanatory fictions can be extremely harmful and represent significant obstacles to effective treatment. For example, owners commonly interpret their dogs' aggressive behavior as stemming from defiant belligerence. Responding under the influence of such an explanatory fiction, the owner may resort to severe punishment, thereby damaging their relationship with the dog and probably making the problem far worse and more difficult to resolve.

Fundamental Attributional Error

Explanatory fictions incorporating dispositional accounts are prone to develop when causal explanations require the consideration of events not immediately present or indicated by situational evidence. Dispositional causes are inferred from the situation, whereas the actual formative causes may not be present in the situation (e.g., adverse or inadequate socialization), but may be far removed from it and unavailable for consideration. Behavior observers tend to underestimate the causal significance of situational factors while overestimating the importance of dispositional factors in the control of behavior—a tendency known as the fundamental attributional error (Ross and Nisbett, 1991). The tendency to emphasize attitudinal or disposition factors (dispositionism) over situational ones appears to be most common in cases where immediate and remote causes (dependent variables) are ambiguous or unknown. In addition to being prone to error and misinterpretation, the assignment of attitudinal and dispositional causes tends to preclude or obscure the consideration of possibly more influential immediate and remote causes affecting a dog's behavior. In this regard, people tend to attribute situational causes to their own actions, while tending to attribute dispositional causes to the behavior of others, probably including other owners and their dogs (actor-observer discrepancy). For example, failing to meet a deadline, a person might explain their shortcoming by appealing to something that unexpectedly came up, whereas, if someone else fails to meet a deadline, there is a strong tendency for an observer to explain it by dispositional causes, such as laziness or the person is not interested in the project, rather than looking for proximal or remote situational causes. Finally, a significant motivation for attributing dispositional mediating causes to behavior is to provide a perception of enhanced predictability and control over it; even if in actuality the causes are fictitious and the treatment a placebo, nonetheless, one may feel more in control!

Dispositional versus Situational Causes

In comparison to the way in which the behavior of children is interpreted, dogs enjoy a significant *positive bias* in the direction of leniency and more favorable attributions (Rajecki et al., 1999). Attributional processes appear to be influenced by the sort of behavior involved. Observers tend to excuse dogs from antisocial behavior while crediting them with responsibility for prosocial behavior. Interestingly, whereas prosocial behavior is commonly attributed to internal and controllable dispositional causes, aggres-

sive behavior is more likely to be attributed to external situational causes not under the dog's control.

Barring obvious limitations and provisos, dispositional attributions are not without value as a sort of predictive shorthand. In fact, emergent dispositional attributions resulting from careful observation are often highly predictive of future behavior. For example, a dog that has repeatedly submitted to owner limit-setting imperatives may rightly be called subordinate and submissive to human control, whereas a dog that consistently resists or defies owner control efforts may be rightly referred to as being competitive or oppositional. To what extent, though, are such post hoc descriptions consistent with the actual causes underlying the submissive and the opposition behavior; that is, to what extent is a dog's obedience to command attributable to submissiveness or disobedience attributable to the influence social dominance? In fact, dogs submit or compete as the result of a variety of causes. A pattern of apparent competition and unwillingness to submit may be due to a dog's temporary inability to exert inhibitory control over its behavior, despite its best efforts to submit to owner control efforts. In such cases, the dog's failure to obey and actively defer is not due to a disposition to compete and defy the owner's authority, but rather may be interpreted as the result of a temporary loss of inhibitory impulse control. Dispositional causes related to impulse-control deficits probably play a significant role in the competitive excesses of puppies. Impulse-control abilities in young puppies are developmentally limited, with dogs only gradually acquiring the neurobiological capacity to exert impulse control in a refined and reliable way. In the case of young dogs, impulse and action are tightly wedded. Efforts to suppress actions may serve only to potentiate and frustrate underlying impulses. The regulation of impulses is probably localized in prefrontal cortex, an area of the developing brain that may not be fully formed until late in the first year with the emergence of enhanced cognitive abilities (Gagnon and Dore, 1994) (see *Learning and Trainability* in Volume 1, Chapter 2).

Dispositional attributions not only affect the diagnosis of behavior problems, they also determine the likely course of treatment. Remembering that dispositional attributions are made in order to enhance control over a dog's behavior, it is logical that behavior believed to stem from defiant competitive motivations would be treated with procedures aimed at increasing a dog's submission to authority. Unfortunately, a dog's degree of submissiveness may be entirely irrelevant with respect to the actual causes underlying its inability to obey owner directives. Whereas physical restraint and punishment may enhance submission in cases where "defiance" is identified as the mediating dispositional cause of competitive behavior, such treatment would be entirely inappropriate in the case of impulsive behavior stemming from hyperactivity, attention or impulse deficits, or immaturity. Unfortunately, such distinctions are not consistently made, and dog behavior problems are often lumped together under the misleading rubric of dispositional causes, such as competitiveness or attention seeking, rather than ontogenetic or situational causes that may be more illuminating and useful. Dogs often seek attention with reference to objectives and needs other than the acquisition of social attention itself (e.g., they seek the owner's attention because they want food or because they want to go outside and so forth); likewise, dogs often compete and oppose owner directives as the result of situational incentives competing for the dog's interest—not as the result of a defiant disposition to resist owner control efforts. Outside of play, where competition may occur solely for the sake of interactive fun, competition is usually limited to situations in which the owner's control directives either thwart or interfere with a dog's enjoyment of some activity, object, place, or other valued resource, including the owner's presence. Other common dispositional causes attributed to competitive behavior may be self-serving to the extent that they are invoked to rationalize abusive training practices. For example, a dog's momentary unwillingness to obey an obedience command may be mistakenly interpreted as stemming from sullen defiance, whereas, in fact, the

dog's disobedience and appearance of sullenness may be due to other causes (e.g., arthritic pain or emunctory distress), giving the appearance of resistance and unwillingness to obey. Without knowing the true causes of disobedience, the trainer may feel justified in using harsh compulsory measures to force the dog to perform.

Anthropomorphic Errors

Much harm is done to dogs as the result of attributing anthropomorphic dispositions and motivations to canine behavior. In general, cynopraxic counselors should resist temptations to unnecessarily attribute complex psychological causes to dog behavior in adherence to C. Lloyd Morgan's famous law of parsimony: "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale" (Morgan, 1894:53). Nowhere is such restraint and self-discipline more necessary than when assessing the situational and dispositional causes underlying aggressive behavior, especially aggression directed toward family members.

Although most dogs are benignly subordinate and submissive toward their owners, some do appear to actively assert limits on their owner's behavior by way of threats and limited attack, suggesting that social dominance may play a dispositional role in the etiology of some forms of CDA. Domestic aggressors may threaten or bite if family members intrude upon a forbidden location, disturb them while resting or sleeping, threaten them with discipline, attempt to take something away from them, attempt to restrain them, and so forth. Of course, most dogs readily give up control over sleeping areas and chew objects, accept handling of all kinds, including punitive treatment, without ever resorting to threat displays or biting. Further, the environmental conditions are relatively constant between dogs that bite and those that do not bite. Why, then, does one dog passively submit while another one threatens or bites? According to the social dominance theory, the primary cause of aggression in such situations is related to social status. The household aggressor either bites in response to a violation of its status or attacks with the goal of improving its social rank. This general theory is problematic on a number of grounds that have been explored in some detail in Volume 2. There are many potential causes standing lower than the defense or enhancement of status on Morgan's psychological scale to explain such behavior that should be systematically excluded when performing a behavioral assessment and diagnosis.

Dominance as a dispositional cause can be easily confused with other remote (e.g., ontogenetic), situational, and dispositional causes (e.g., irritability and frustration) that may be more directly relevant to behavior-therapy efforts. Although competitive conflicts may escalate into aggression, aggression is not necessarily the result of motivations associated with dominance, particularly not in sense of status and rank. For example, although dogs may become aggressively aroused when they are pulled away from sleeping or resting areas, the incentive to threaten or bite at such times may be borne out of a momentary autoprotective incentive to expediently control irritating or frustrating interference. Such domestic aggressors are not necessarily challenging family members for rank, but are simply responding reactively and incompetently to the handling and the momentary loss of comfort and safety. Dogs of this sort may lack the socialization and training necessary for them to respond in a more socially acceptable and cooperative way to intrusive and provocative handling. However, as the result of repeated offensive threats toward the owner, the dog may gradually assume a dominant relation toward the owner. This sort of CDA is most likely to result in ritualized threats and inhibited punitive biting, not severe and uninhibited bites that are commonly attributed to dominance.

Dogs that deliver hard and uninhibited bites often do so under the influence of varying degrees of panic and an apparent loss of impulse control—the antithesis of competent social dominance. The attacks of such dogs are often out of character, highly exaggerated, and disproportionate to the provoking stimu-

lus. Such aggression frequently occurs under the influence of circumstances similar to that just described, but the attacks seem to differ with respect to the level of emotional arousal, the degree of competency and control over the action, and their severity. Panic-related aggression appears to occur in association with heightened autonomic arousal, behavioral rigidity, and a conflux of coactive emotional influences (e.g., anger, irritability, frustration, and fear) resulting in the catastrophic dysregulation of aggressive impulse. When punished, such dogs do not back down or retreat, giving them an appearance of fearlessness. Instead of submitting or fleeing when punished, panic aggressors tend to escalate their attacks rapidly under the excitatory influence of fear. In contrast to the impulsive character of panic-related attacks, competent control-related aggression is more likely to occur in accordance with prediction-control expectancies and a cost-benefit assessment, such that aggressive challenges or threats are rapidly abandoned if they prove too costly when they fail or offer little promise of benefit when they succeed.

Social Dominance as a Dispositional Cause of Aggression

Erringly identifying the causes of aggression as stemming from a dominance conflict may result in the initiation of training efforts designed to enhance owner dominance and control—efforts that may or may not be relevant to the actual causes underlying the problem. In other cases, the attribution of dominance may result in the use of highly intrusive and aversive procedures believed to alter canine social status.

The attribution of social dominance in the sense of rank or status as a primary cause of CDA is flawed and inconsistent with Morgan's law of parsimony. Most instances of CDA can be interpreted in terms of functional causes, including conditioned expectancies, adverse emotional influences, and conflict. Consequently, the term *control related* appears to more closely approximate and capture the intent and significance of such aggressive behavior. In any case, the term *dominance* is primarily used here in the sense of limit-setting actions, that contribute to social competency and foster the integration of a submissive bond. Domestic aggression most often reflects the influence of social confusion and a failure of the owner and the dog to interact in an organized and competent way with each other. As the result of past competitive successes involving aggression, attacks against family members may become more frequent and severe under the influence of conditioned aversive arousal (anxiety, frustration, irritability, or anger), stress-related disturbances, and the presence of inadequate social coping and communication skills.

Adverse Environmental and Emotional Influences and Canine Domestic Aggression

Most CDA currently attributed to dominance lacks a confident quality, making the diagnostic attribution of *dominance related* highly suspect in such cases (Guy et al., 2001). Such aggression appears to be more anxious and reactive than proactive and fearless. Impulsive aggression occurring under the influence of conflict might best be described as *autoprotective*. Instead of speculating and attributing excessive causal significance to rank and household dominance hierarchies, the causes of most CDA can be better understood and described in terms of distal polymorphic variances (individual differences) affecting excitability, fear and anger thresholds, and sociability; ontogenetic influences such as prenatal and postnatal stress, exposure to early adversity (abuse or neglect), socialization and habituation deficits, and toxic expectancies; the presence or absence of protective social nurturance and training; and proximal provoking situations and social triggers, reactive coping styles and ISSs, diminished capacity to regulate emotion and impulse, coactive establishing operations (e.g., anger, fear, excitability, irritability, frustration, and conflict), and allostatic load. Although threat displays can advertise relative social rank and status, these social signals can also reflect underlying coactive emotional and motivational states and a heightened readiness to act in particular ways to control a provocative situation (Figure 7.1), inde-

pendently of standing dominant-subordinate relations. Aggression in association with owner control efforts typically involves varying degrees of elicited irritability, frustration, anger, or fear. Aggression in such cases is often triggered by owner interference or disturbance, conflicting with appetitive-seeking and comfort-seeking activities (control incentives or *vectors*). Gradually, as the result of actual or anticipated threats or losses, a dog may become progressively vigilant and irritable when approached, thereby gradually lowering aggression thresholds in association with owner intrusion or interference (comfort/safety violations). For example, approaching a dog with a history of object guarding and aggression while it is in possession of a bone evokes varying amounts of conditioned anger or irritability, emotional changes established in association with a history of owner intrusion and interference. Dogs prone to react aggressively to social signals associated with discipline (e.g., loud voice, direct stare, or abrupt reaching or leaning over actions) and restraint may also be responding under the influence of varying degrees of anxiety, frustration, or anger stemming from past experiences associated with positive or negative punishment (see *Anxiety, Frustration, and Aggression* in Volume 2, Chapter 8). These two general sources of aggressive arousal are respectively referred to as loss of comfort and loss of safety. *Comfort loss* refers to interference or intrusion upon activities and sources of stimulation that the dog would wish maintain or intensify. *Safety loss* refers to interference or intrusion that involves a threat or presentation of events that the dog would prefer to escape or avoid. Provocative comfort loss or safety loss are the two primary ways in which control-related aggression develops. The traumatic loss of comfort or safety may be especially problematic in dogs having formed close attachments with their owners (loss of trust), in dogs that have not learned how to cope competently with loss, in dogs exposed to provocative comfort and safety loss on a relatively unpredictable or uncontrollable basis (conflict), and in dogs operating under the influence of toxic expectancies resulting from a history of traumatic or abusive handling.

In addition to social causes, biogenetic and developmental influences appear to predispose some dogs to develop aggression problems. Dogs with reactive and excitable temperaments appear to be more prone to exhibit CDA (Dodman et al., 1995; Borchelt, 1986; Podberscek and Serpell, 1997; Luescher, 2000; Guy et al., 2001b). The combination of low fear and anger thresholds, presenting with a high degree of excitability, may strongly predispose dogs for developing CDA problems in association with impulse dyscontrol and panic. Panic-related aggression occurs under the influence of adverse emotional stressors and provocative conditioned and unconditioned triggers that overstrain a dog's ability to control aggressive impulses. Such dogs may bite, not as the result of control-related incentives or dominance, but rather because of an inability to cope competently with a provocative situation. Panic-related aggression occurs as the result of a momentary loss of control over aggressive impulse. In contrast, control-related aggression refers to competent (proactive) and incompetent (reactive/impulsive) efforts organized to assert control over aversive or intrusive social events portending a loss of security (threat to comfort or safety). Control-related aggression includes both offensive (anger-related) and defensive (fear-related) forms occurring under the pressure of autoprotective incentives. Whereas panic-related aggression appears to stem from an internal loss of control over arousal states anticipating rage, control-related aggression is triggered by an external loss of control over significant social exchanges that can present with competent proactive forms aimed at promoting adaptive optimization by taking advantage of favorable cost-to-benefit ratios or incompetent forms (reactive and impulsive aggression) operating under the adverse influence of social ambivalence (anxiety) and irritability. In any case, most forms of competent and incompetent aggression are expressed as means to ends in subservience to autoprotective interests and concerns rather than the pursuit of social dominance and rank. Rather than attempting to alter the dog's perception of rank, training efforts should be dedicated to restoring or developing a social bond based on trust in situations

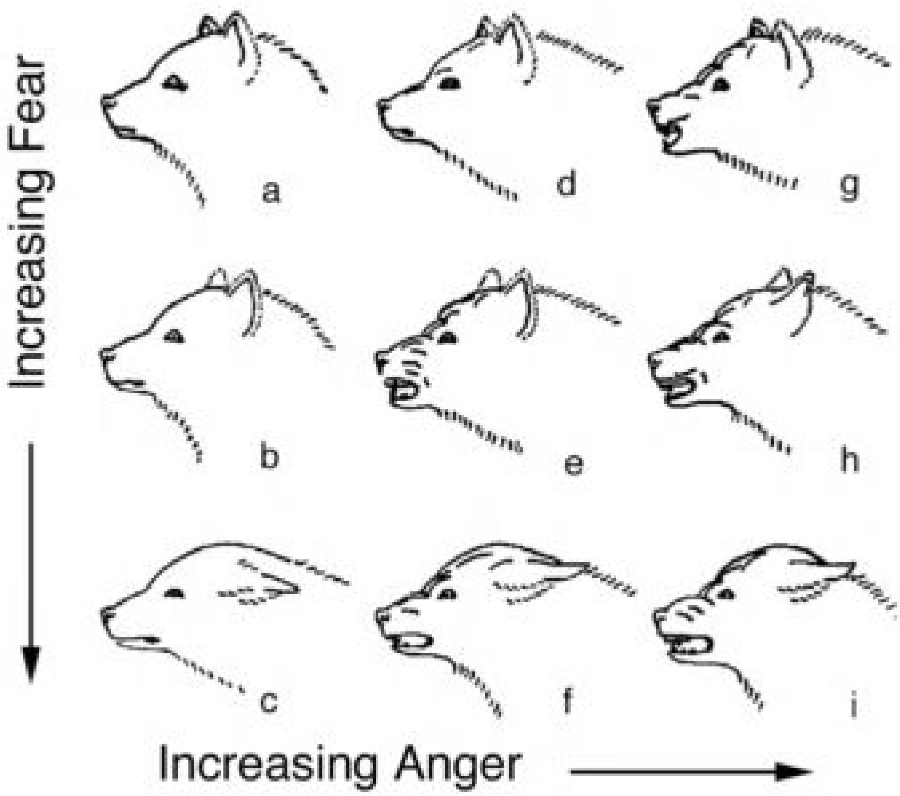

FIG. 7.1. Aggression occurs under the influence of varying admixtures of coactive emotional influences, such as anger and fear. These emotional states are reflected in a variety of postural and facial changes or signs that provide the receiver with information about the sender's probable course of future action, thereby enabling the receiver to better anticipate (predict) and adjust (control) to the impending situation. The facial expression in *drawing i* indicates signs of intense emotional arousal associated with the simultaneous provocation of high levels of fear and anger, a state of conflicted arousal that may overstrain executive impulse-control functions and result in explosive panic-related attacks in predisposed dogs. After Lorenz (1966).

that have provoked aggression in the past (Table 7.1).

Social Communication and the Regulation of Aggression

Functional Significance of Social Signals

Social communication provides a conduit of exchange and information about what affiliative partners are most likely to do in advance of them actually doing it (see *Communication and the Regulation of Social Behavior* in Volume 1, Chapter 10). In addition to signaling the sender's intent, communication serves to elicit preparatory emotional responses readying the receiver to act in certain ways. Depending on the sort of signal or display sent, the receiver is rendered more or less likely to greet, play, attack, submit, flee, and so forth; that is, the signal sets the occasion and elicits the emotional concomitants necessary for the emission of a certain class of behavior. As such, signals serve the dual function of discriminative stimuli and establishing

operations. As discriminative stimuli, social signals announce a moment when a particular set or class of behaviors is most likely to result in reinforcement. As establishing operations, social signals momentarily alter a dog's motivational readiness to behave in ways that are in keeping with the discriminative significance of the social signal presented (see *Antecedent Control: Establishing Operations and Discriminative Stimuli* in Volume 1, Chapter 7).

In an important sense, effective social communication serves to make the behavior of the sender and the receiver more predictable and controllable to each other; that is, the exchange of orderly social signals helps to promote more trustworthy and reliable interaction. Under the influence of an orderly exchange of social signals and mutual adjustments consistent with those signals, social behavior is gradually shaped and refined in the direction of enhanced interactive harmony, whereas, on the other hand, social signals that lack a consistent and orderly significance and presentation tend to impede the development of interactive harmony, resulting in increased levels of social conflict, anxiety, and frustration. As a result of interaction lacking consistency and orderliness, varying degrees of unease, distrust, tension, and potential for disturbance are inexorably introduced and maintained under the influence of deranged reinforcement contingencies and classical conditioning. In the context of aversive emotional arousal occurring in association with aggressive behavior, a lack of quality predictive information may lower aggression thresholds via anxiety, thereby increasing a dog's readiness to engage in disorganized defensive behavior.

Social signals involve both conditioned and unconditioned elements helping to make social interaction more predictable. Signals serving an establishing operation function are strongly influenced by feed-forward mechanisms that collect and appraise predictive information via the influence of classical conditioning (Domjan et al., 2000). Feed-forward information gives advance notice or warning of what is about to occur on the basis of what has occurred under similar circumstances in the past, thereby enhancing an animal's ability to control the impending occurrence by means of anticipatory adjustments that prepare it for appropriate action. Predictive social signals serve to make social interaction more effective and efficient, whereas unpredictive signals introduce escalating levels of anxiety and stress. Many common canine aggression problems appear to be under the control of Pavlovian feed-forward expectancies and instrumental contingencies of reinforcement. In addition, conditioned and unconditioned aversive and appetitive stimuli exert a direct excitatory or inhibitory effect on instrumental behavior, providing powerful means for modulating aggressive arousal and behavior (Dickinson and Pearce, 1977).

Dogs work to escape or avoid aversive social stimulation by means of behavioral adjustments that result in a reduction of the threat while simultaneously searching for safety from the danger. When the owner is

TABLE 7.1. Treatment of intra-familial aggression involves a multifaceted program consisting of at least eight elements

1. Exclude possible medical causes by veterinary examination and appropriate testing.
2. Obtain a thorough history and assess aggressive behavior.
3. Identify and reduce coactive emotional influences.
4. Systematically elevate pertinent aggression thresholds.
5. Improve the predictability and controllability of social interaction.
6. Promote interaction that is conducive to a restoration of trust between the family and dog.
7. Train the dog to respond more competently to situations involving appetitive loss or aversive threat.
8. Avoid unnecessary and provocative situations that may increase aggressive tensions or evoke actual attacks.

both the source of aversive stimulation as well as the dog's primary source of safety, a high degree of emotional conflict is likely to ensue with increasing levels of ambivalence, irritability, and intolerance. The traumatic disconfirmation of comfort and safety is hypothesized to evoke high levels of anger and fear, setting the emotional stage for reactive panic and aggression. Dogs that have formed close attachments with their owners may be energetically aroused by punishment, experiencing an unexpected discrepancy between a history of comfort and safety (security) conducive to trust and its rapid and traumatic loss. In cases where aversive stimulation is combined with an inescapable condition in which the owner ignores submissive signals and prevents the dog from getting away or otherwise controlling the punitive stimulation, biting to break free may be the dog's last resort. In the future when faced with situations portending similar treatment, the dog may preemptively threaten or bite the owner and flee to a hiding place in search of safety and protection. This is a very problematic state of affairs that frequently presents in close association with CDA problems. Such owners need to learn how to control their dogs more kindly and skillfully, while, on the other hand, such dogs need to learn how to respond more competently to social situations demanding obligatory subordination and cooperation. The dog's trust in the owner as a reliable source of comfort, safety, and consistency must also be restored—a change that is facilitated by cynopraxic training and therapy, attention and relaxation training, play, and a variety of predictable and controllable friendly interactions signifying comfort and safety to the dog. The cynopraxic process integrates owner relations with the dog consistent with a tend-and-befriend orientation, thereby activating a mutually beneficial antistress response, while mobilizing a VSS incompatible with flight-or-fight reactions.

Social Signals, Impulse Control, and Attention

Accurate prediction and control foster behavior that is appropriate to the circumstances in which it occurs—something that is commonly lacking in the case of CDA problems. Overstrain of attention and impulse-control faculties by adverse conflictive pressures originating from internal (e.g., emotional disturbances and stress) or external sources (e.g., unpredictable and uncontrollable events) may significantly impact upon a dog's ability to regulate its behavior, including aggressive impulses. Emotionally provocative stimulation occurring on a relatively frequent, unpredictable, and uncontrollable basis may be particularly problematic, inducing a high degree of conflict and stress. Dogs possessing unstable temperaments (choleric and melancholic types) may be more prone to exhibit various disorganized and maladaptive coping efforts when exposed to deranged environmental contingencies. Disturbances in attention and impulse control resulting from deficient prediction and control may also occur in situations where events are quite orderly but remain elusive to the dog because it has not yet learned how to apprehend them as such. Such difficulties may develop in association with inadequate socialization and training efforts. In such cases, remedial basic training may provide a therapeutic benefit by means of explicitly presenting significant events on a highly predictable and controllable basis—an influence conducive to enhanced social competence, confidence, and relaxation. Training activities also enhance both attention and impulse control, thereby improving human-dog communication and cooperation. Improved communication and cooperation promote interactive harmony and social trust between the dog and the owner, as well as helping to reduce physiological stress. Highly structured programs of ICT probably derive most of their aggression-reducing benefits from the enhancement of attention and impulse control rather then serving to alter the dog's social status. Finally, even though some dog-training authorities have overstated the importance of social dominance for regulating social interaction between people and dogs, the establishment of social order by limit-setting activities remains a necessary part of the training and socialization process.

Social Competition, Cooperation, Conflict, and Resentment

Social interaction integrating dominant and subordinate relations into cooperative activities by means of limit-setting actions, reward-based training, and play promotes emotional establishing operations and modal strategies conducive to social harmony. Under the ideal conditions of voluntary subordination, the filial/sibling subordinate defers to the leader/trainer's limit-setting actions with submission behavior. The leader/trainer nurtures active submission (affection and care seeking) with contingent rewards arranged to shape a cooperative pattern of interactive behavior. Essentially, cooperation is *gratified begging* organized to promote a friendly leader–follower bond.

Voluntary subordination is most likely to occur under conditions of minimal coercion, positive reinforcement, and play, whereby the subordinate's need for affectionate contact, nurturance, and protection are met by means of voluntary compliance to the trainer's leadership directives. The VSS is characterized by elevated mood (elation) associated with the success and safety obtained by cooperative compliance with a competent leader. Under the influence of adverse conditions in which subordination is coerced by means of punishment and maintained by threats, an ISS may develop in association with increased resentment and potential for CDA. The loss of effective social control and the ensuing conflict-related stress associated with ISS may result in depressed mood, increased irritability, and reduced tolerance for close contact and taction. The adverse effects of persistent involuntary subordination on emotional tone and mood have been theoretically implicated in the etiology of depressive illness in people (see Gardner, 1982; Price et al. 1994; Price and Gardner, 1995). In addition to social incompetence and intolerance, many offensive aggressors appear to be strongly affected by increased levels of anxiety and vigilance associated with involuntary subordination. Within the context of the family structure, these negative emotions may be selectively exhibited toward family members, depending on social considerations. During interaction with inferiors (e.g., children), the involuntary subordinate may exhibit heightened irritability and intolerance, whereas interaction with superiors (e.g., adults) may evoke vigilance and resentment. Interestingly, such dogs may show a particular fondness and tolerance toward children and adults incapacitated in various ways that prevent them from exerting a control threat to the dogs.

Species-typical Defensive and Offensive Aggression

Generally speaking, aggression is a risky activity that operates within limits of cost-benefit expectancies, weighing the benefits of success set against the potential costs of failure (see *Cognition and Aggression* in Volume 2, Chapter 6). Aggressors attack under a risk that the target victim might fight back and, in doing so, perhaps injure or kill the aggressor. The threat of punitive retaliation exerts a significant inhibitory effect over animal social aggression (Clutton-Brock and Parker, 1995). Punitive retaliation against violence is a natural and virtually universal response, the assumed effectiveness of which is reflected in its ancient origins and continuous worldwide practice as a preferred means to inhibit aggressive behavior. Despite these natural and cultural precedents for the use of punishment to control aggression, punishment in the case of CDA is complicated and generally avoided except in the case of overt attacks. Even in the case of overt attacks, though, punishment poses serious challenges and risks. Punishing an adult dog while it is in the act of an overt attack risks producing a more dangerous situation via vicious-circle effects (Melvin, 1971) (see *Reactive Types* in Chapter 5). If the punitive effort is insufficient to produce immediate inhibition, the escalating attack may continue until the punitive effort is discontinued, often at the moment at which the dog succeeds in breaking free by biting. As a result of ensuing negative reinforcement occurring at such times, threats or attacks may rapidly escalate and morph into a much more dangerous form in response to future owner control efforts. In addition, preemptive attacks may begin to occur in response to benign body

movements that resemble actions associated with the failed punitive effort (e.g., reaching or leaning over the dog). These adverse byproducts of punishment strongly militate against its use in the treatment of most forms of aggression.

Dogs respond to aversive events with a variety of species-typical defensive reactions (SSDRs), which provide rapid behavioral adjustments to threatening situations. SSDRs are highly stereotypic, phylogenetically significant, easily evoked, and rapidly learned as avoidance responses (see *Species-specific Defensive Reactions* in Volume 1, Chapter 8). In addition, dogs exhibit a variety of species-typical offensive reactions (STORs) that occur in response to socially provocative stimulation involving pain or frustration and the induction of anger. Antecedent social and contextual stimuli present at the time of provocative stimulation may be conditioned to control the preemptive expression of SSDRs and STORs. Not only is avoidance learning rapid, conditioning resulting in avoidance-related aggression is highly persistent and durable (see *A Cognitive Theory of Avoidance Learning* in Volume 1, Chapter 8; and *Conditioned Fear and Extinction* in Volume 2, Chapter 3). Whether a dog attacks or withdraws during punishment depends on biogenetic and developmental influences (temperament) affecting the functional thresholds controlling such behavior (see *Behavioral Thresholds and Aggression* in Volume 2, Chapter 8). Dogs possessing a low fear threshold and a high aggression threshold show a propensity to become fearful first, causing them to respond to aversive stimulation by various flight or freeze responses, such as running away or becoming rigid. At the other extreme, dogs with a low aggression threshold combined with a high fear threshold may rapidly transition into attack mode in response to minimal provocation.

Fearful dogs struggling to escape interactive punishment may eventually threaten or attack under the influence of escalating aversive arousal. Rather than flee or freeze in the future, these dogs may rapidly learn to threaten or bite preemptively in response to provocative social stimuli (see *Avoidance Learning and Aggression* in Volume 2, Chapter 6). Under the same interactive punishment, dogs exhibiting low aggression thresholds may eventually reach a fear threshold, causing them to freeze or flee or energizing their aggressive efforts under the excitatory influence of fear. Dogs exhibiting low behavioral thresholds for fear and aggression may be highly reactive and intolerant of provocative social stimulation. When exposed to physical punishment, such dogs may rapidly become enraged under the reciprocal excitatory influences of fear and anger on panic/rage circuits. Under the influence of sustained punishment, such dogs may become progressively violent (panic-related aggression). Dogs affected by elevated fear and aggression thresholds tend to exhibit tolerance for provocative social stimuli and enjoy a natural protection against the development of aggression problems.

Guy and colleagues (2001c) have questioned the relevance of dominance as an etiological factor in the development of CDA problems, arguing that aggression problems may be more closely related to the expression of temperament traits (e.g., excitability) and social anxiety/fear, perhaps more significantly so than social dominance. Such behavioral and emotional influences may be exacerbated by the use of punitive methods of control, perhaps further increasing the risk of aggression—practices that may be particularly problematic in the case of puppies showing low anger thresholds in combination with low or high fear thresholds. In such cases, physical punishment may trigger panic-related reactive aggression (low anger and low fear thresholds) or fearless attack (low anger/high fear thresholds) or cause aggressive behavior to rapidly escalate via avoidance learning and vicious-circle effects (Brown et al., 1964). Punishing reactive or fearless puppies may only serve to sensitize them to signals of punishment, however, instead of inhibiting the target behavior, punishment may actually increase aggression via vicious-circle effects, perhaps making the behavior more difficult to predict, control, and manage.

The use of interactive punishment for the control of aggression is problematic, but especially so when it is applied against threat displays (e.g., growling and snarling). The punishment of threat displays may cause dogs to

withhold threats and possibly to learn to bite without warning. Growling and other threat displays provide a trainer with valuable information about a dog's emotional state as well as give advance warnings of impending attacks. As a result, threat displays provide a layer of safety to family members and others coming into contact with the dog—protection that may be removed by punishment. In addition to potentially suppressing valuable warnings, punishing a threat display risks triggering an escalation of aggressive tensions, especially in the case of excitable dogs, perhaps triggering an overt attack and breaking the ALL IMPORTANT inhibition controlling the first hard bite. After the first bite, subsequent biting becomes much easier for dogs. The power of the native canine inhibition against biting can never be duplicated by any amount of training and, once it is broken, can never be fully restored.

Instead of punishing aggressive threats, it is far better to reduce the frequency of threatening behavior by modifying the social and environmental causes controlling it. Growling and other threats should be viewed as useful diagnostic signs and protective warnings that should be monitored and reduced by displacing aversive arousal with incompatible emotional and behavioral responses conducive to friendly cooperation and play. One option for managing trigger situations is to avoid them whenever possible and practical. For example, in the case of dogs whose threats or attacks occur only in the context of control-related incentives associated with physical punishment, owners can be encouraged not to use such methods of training. Physical punishment is something that owners can easily learn to live without after learning how to control and train their dogs by less intrusive and provocative means. However, in cases involving critical and unavoidable interaction with dogs (e.g., approaching, touching, handling, grooming, or restraining), various behavior-therapy and training procedures should be introduced to help manage and reduce the risk of future aggression while shaping various behavioral changes incompatible with aggression and promoting interaction that supports enhanced safety and trust. Finally, behavioral thresholds controlling fear and aggression are strongly influenced by experience. Puppies with low fear and low anger thresholds should be identified at an early age and provided with appropriate socialization and training. Although such puppies are at an increased risk of developing behavior problems associated with fear or aggression, owner counseling and early intervention appear to provide a protective influence.

LOSS OF SAFETY, DEPRESSION, PANIC, AND AGGRESSION

The formation of a close attachment between the owner and dog appears to be a necessary condition, but not a sufficient one, for the development of both reactive separation distress and CDA. A common link shared by these social behavior problems is the presence of conflict-related stress and panic occurring in association with the loss of comfort and safety (security). In the case of separation-distress syndrome, the loss of the attachment object at separation provokes varying degrees of distress under the coactive influences of anxiety, frustration, and panic, whereas, in the case of CDA, a loss of safety resulting from provocative stimulation at the hands of an attachment object may result in varying degrees of vulnerability and conflict under the coactive influences of anger, fear, panic, and rage (Figure 7.2). As an object of attachment, comfort, and safety, the owner may evoke significant conflict in the dog when delivering physical punishment producing high levels of pain and fear (see *Drive Systems, Aggression, and Behavior Problems* in Chapter 6), potentially resulting in a dramatic and permanent loss of security and trust. The potential for loss of trust and panic-related aggression is particularly high in situations involving abusive and inescapable punishment directed toward dogs with reactive temperaments (low fear/low anger threshold). As the result of traumatic stimulation and loss of trust, persistent toxic expectancies may form and mediate the expression of panic-related aggression in response to conditioned social stimuli present during the traumatic event. According to

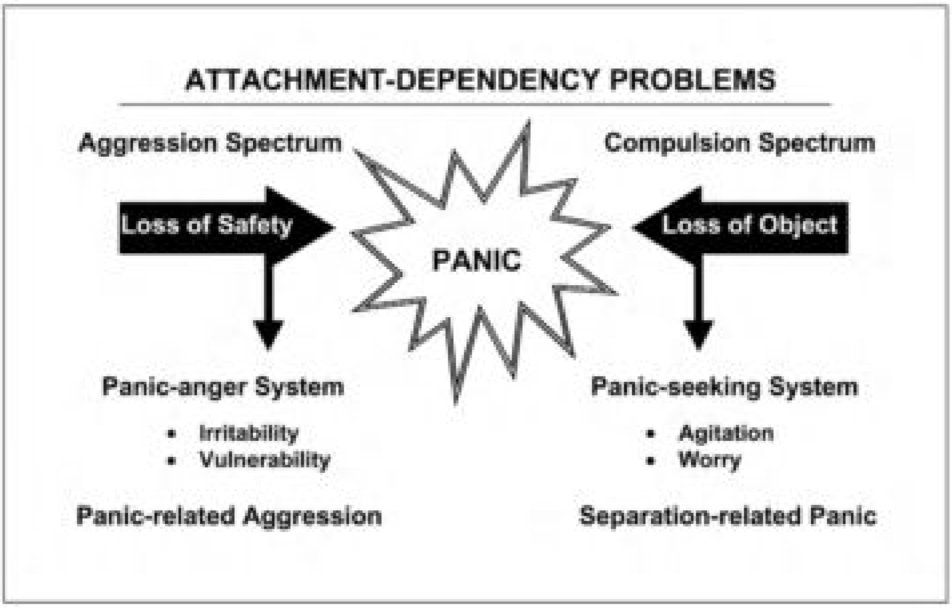

FIG. 7.2. Panic may play a pivotal role in the etiology of severe separation-related distress problems as well as certain presentations of owner-directed aggression, commonly described as dominance related. Both behavior problems appear to involve predisposing biogenetic, developmental, and experiential (e.g., toxic expectancies) influences that render a dog persistently vulnerable to attachment-related loss in association with owner separation (loss of object) or owner intrusions or interference (loss of comfort or safety). Following the emotional command system devised by Panksepp, separation-related distress may acquire an exaggerated and compulsive form as the result of panic-induced dysregulation affecting the seeking system (compulsive spectrum), whereas panic-related aggression may result in exaggerated and impulsive-episodic aggressive behavior (aggression spectrum) occurring as the result of panic-induced dysregulation of the anger-rage system. Both separation distress-panic and panic-related aggression tend to escalate dramatically under the excitatory influence of fear in contrast to the inhibitory effect that fear tends to produce on presentations of separation distress and owner-directed aggression not under the influence of panic.

the panic theory of CDA, provocative stimulation resulting in the loss of trust by a familiar social object may result in heightened autonomic arousal, the precipitous activation of anger-panic circuits, and the eduction of a momentary loss of control over aggressive impulses. Under the influence of panic, predisposed dogs may threaten or attack with bites of varying magnitude, but frequently resulting in grossly exaggerated and uninhibited bites. Many panic aggressors exhibit a distinctive red-glow or glazed-eye look in anticipation of an attack, indicating intense sympathetic arousal. In addition to heightened autonomic arousal, panic aggressors often appear fearless, belying the anger-induced nature of such attacks. Owners of panic aggressors often describe attacks as being out of character and inappropriate with respect to provoking stimulation.

Although an element of familiarity and affection (attachment) appears to be a necessary precondition for panic-related aggression to develop, many dogs form close attachments with balefully cruel owners and endure egregious violations of safety and loss of comfort without ever losing control and attacking their tormentors. In some cases, the dog may feel helpless and may simply passively absorb the abuse, perhaps redirecting it at some point with a vengeance toward an unsuspecting and innocent victim that comes into contact with

the dog. In other cases, the tolerance exhibited by such dogs may be under the protection of biogenetic and developmental influences that promote elevated aggression thresholds (see *Phylogenesis, Polymorphism, and Coping Styles* in Chapter 6). Finally, the tolerance of some of these dogs for the loss of safety and comfort may be the result of a highly flexible bond structure that prevents the violation of trust as a result of threatening treatment (see *Cynopraxis, Antistress, and a Tend-and-Befriend System* in Chapter 6). These observations suggest the possibility that panic-related aggression may depend on an attachment that lacks a trust-forming or trust-protecting bond structure. The failure of such dogs to form flexible and tolerant relationships based on feelings of safety and trust may reflect the influence of inadequate or inappropriate socialization and training efforts (see *Drive Systems, Aggression, and Behavior Problems*). Such dogs may also be affected by biogenetic and developmental deficiencies that contribute to their inability to form viable and trusting bonds with their owners (see *Origin of Reactive versus Adaptive Coping Styles* in Chapter 4). In particular, dogs exhibiting low anger and fear thresholds from an early age may be especially prone to develop explosive panic-related aggression problems in adulthood (see *Behavioral Thresholds and Aggression* in Volume 2, Chapter 8).

Attacks associated with panic appear to be produced by an energetic synergy of anger and fear, perhaps resulting from a traumatic cross-association of anger and fear systems during a sensitive period of neurobiological development. The simultaneous elicitation of anger and fear is hypothesized to mobilize an all-out attack or rage response. Retaliatory punishment directed against impulsive aggression may release a more serious panic-driven attack. Instead of reducing the future risk of aggression, punishment may only worsen the situation by establishing conditioned triggers that cross-associate fear and anger circuits so that activating the one activates the other. The simultaneous elicitation of fear and anger by conditioned triggers may help to explain the exaggerated and disproportionate nature of such attacks.

Even innocuous interaction with family members may be highly stressful for such dogs. Under the influence of benign threats, anxiety may excite anger via cross-associations with fear circuits, which in turn may trigger more anxiety and set into motion a rapid escalation of aggressive arousal until a point of panic and dyscontrol is reached and a hard bite is delivered. In the case of proactive aggression, anger is an emotional establishing operation, recruiting a confrontational sequence. When adaptively aroused, anger is precisely calibrated and matched to the needs of the situation and adjusted in real time. This ability to monitor and adjust aggressive arousal and output depends on the presence of prediction-control expectancies and comparator-feedback networks assessing sensory input for prediction discrepancies. Under normal circumstances, worse-than-expected outcomes shift emotional establishing operations toward adjustments that increase agonistic risk or reduce it. These adjustments to negative prediction error are made under the influence of frustration (anger increasing) and anxiety (fear increasing). Under adaptive circumstances, frustration increases readiness for intensifying aggressive output (fight), whereas anxiety increases vigilance for threats and prepares a dog for fearful retreat (flight).

Under conflictive situations involving a collision of fight and flight vectors, a reactive response based on a slight shift of frustration or anxiety may cause a predisposed dog to attack or retreat, that is, result in a rapid and extreme *catastrophic* adjustment, not just making it more vigilant and ready. According to Zeeman's (1976) catastrophic model of canine aggression, a dog experiencing high levels of anger and fear has only two options available to it: fight or flight. However, such extreme adjustments to situations posing significant unknowns and risk would be adaptive only under circumstances where the cost (risk of injury or loss of social benefits) was significantly outweighed by the potential benefits of succeeding. Consequently, agonistic conflict situations brought on by escalating anger and fear may also be resolved by a third alternative: mutual forbearance and compromise. Instead of relying on catastrophic adjust-

ments, the conflict situation is optimally resolved by mutually disengaging and cutting off animosities, compromising, and engaging in mutually reassuring and comforting reconciliation rituals. Such a strategy of mutual forbearance avoids the potential harm done if the conflict were allowed to escalate into an active fight or flight situation. Whether an agonistic conflict escalates into a reactive situation or not is often determined by the owner's capacity to lead, the quality and strength of the relationship, the social dynamics and stability of the family, the presence of trust, and an established history of the dyad resolving and reconciling differences amicably: "Every reconciled conflict is a choice against entropy" (De Waal, 1996:165). As the result of a tend-and-befriend leadership style and the competent management of conflict and reconciliation, the dog acquires emotional expectations and behavioral adjustment strategies that are incompatible with escalating anger or fearful arousal when exposed to social conflict (threats or challenges). Instead of confronting or retreating, the dog learns to flirt and forbear when experiencing anxiety or frustration in conflictive situations. If instead of encouraging compromise, forbearance, and reconciliation, the dog is severely punished and prevented by force from escaping at such times, it may attempt to break free by biting. In any case, the dog will lose its ability to trust the owner in proportion to the frequency, severity, and uncontrollability of such punishment. Instead of learning to inhibit aggression as the result of such treatment, the dog may attack more readily in the future under the influence of a cost-benefit assessment that now includes a self-preservation incentive; that is, the dog may struggle and fight as though its life depended on it.

Although Zeeman's catastrophe model may provide a useful set of predictions concerning reactive adjustments to conflictive situations involving escalating anger or fear, especially conflicts occurring between strangers exhibiting approximately the same anger and fear thresholds, the model does not offer much empirical or predictive value with respect to adaptive adjustments exhibited by dogs responding under the influence of divergent social dynamics (e.g., relative familiarity, affection, and trust) affecting their agonistic readiness to confront or retreat when aroused with anger or fear. In addition to not providing a cutoff option or an adaptive flirt-and-forbear strategy to cope with escalating anger and fear, Zeeman's model does not appear to predict the passive response of dogs expressing high anger and fear thresholds. Such dogs may neither attack nor retreat, but may instead respond to increasing anger and fear by becoming immobile (freeze) and wait for the aversive situation to change.

Similarly, depressed human patients frequently exhibit reduced positive affect together with episodic anger attacks that are frequently described as being uncharacteristic of their typical demeanor and out of accord with the provoking situation. Anger attacks occurring in association with depression resemble human panic attacks but without the prominent influence of fear and anxiety (Fava and Rosenbaum, 1998). Finally, perpetrators of domestic violence are often affected by a precipitous increase of autonomic arousal and loss of control occurring in association with violent attacks. The investigation of domestic violence reveals intriguing parallels with significant potential implications for understanding panic-related aggression in dogs (see *Autonomic Arousal, Heart Rate, and Aggression* in Chapter 6).

Both panic-related and avoidance-related types of aggression are often lumped together under the heading of dominance aggression. Although some superficial similarities exist, panic-related aggression and aggression associated with anxiety and avoidance differ from each other in several important respects. Panic-related aggression is most commonly directed against family members or others with whom the dog is closely familiar and otherwise affectionate toward, whereas avoidance-related or avoidance-*motivated* aggression is often directed against both family members and others with whom the dog is not familiar or on friendly terms (see *Avoidance Learning and Aggression* in Volume 2, Chapter 6). Panic-related aggression rapidly escalates under the excitatory influence of coactive anxiety and fear, to reflect a reactive

loss of executive control over aggressive impulses. Avoidance-related aggression, on the other hand, is primarily of a defensive origin, but can be intensified under the secondary influence of anger and success, causing it to become progressively brave and preemptive. Panic-related aggression and avoidance-related aggression also differ in terms of the degree of control that a dog has over its aggressive impulses. Whereas panic-related aggression presents in ways that indicate compromised impulse control and a high level of autonomic arousal (e.g., fitlike attacks and red glow in the eyes), avoidance-related aggression usually occurs under the influence of significant impulse control, with avoidance threats and bites delivered under the influence of control-related incentives and expectancies. In contrast to the reactive and hard biting of panic aggressors, avoidance aggressors more often show well-targeted and inhibited bites, air snapping, and fang whacking, and much less frequently produce serious bites. Avoidance-related aggression is often associated with signs of conflict (threats), whereas panic-related aggression is more impulsive and often performed with little or no warning. Finally, unlike panic-related aggression, avoidance-related aggression is much more sensitive and responsive to the effects of reward and punishment. Consequently, whereas avoidance-related aggression falls under the category of control-related or proactive aggression, panic-related aggression is placed under the heading of impulsive or reactive aggression (see *Panic, Impulsivity, and Episodic Dyscontrol* in Chapter 8).

PART 2: ASSESSING AND TREATING CANINE DOMESTIC AGGRESSION

CANINE DOMESTIC AGGRESSION: ASSESSING THE THREAT

Dogs that bite family members defy simple characterization, exhibiting a wide spectrum of social traits and behavioral histories. Aggressive dogs may appear to be socially independent and aloof, serious-minded, depressed, or moody. However, depression and lack of positive affect are not representative of all canine aggressors. In fact, many owners of biting dogs report that the dogs are genuinely affectionate and playful most of the time (Borchelt, 1983), but rapidly shift from an affectionate mode of interaction to become distant, irritable, and threatening. Many owners report that aggressors show contrition or signs of remorsefulness following an aggressive episode (Voith and Borchelt, 1982). Typically, the aggressor threatens or attacks only when it perceives a challenge or imminent threat to its control over some situation. Aggressive dogs may exhibit a variety of threatening displays, such as direct staring, growling, snarling, stiffening, raised hackles, air snapping, and inhibited biting, prior to actually delivering an overt attack. Some aggressors do not show any reliable signs or warnings at all in anticipation of an impending attack. Although aggressors sometimes bite hard and cause severe injuries, the majority of domestic dog bites are inhibited punitive snaps, aimed at controlling irritating, frustrating, or threatening stimulation.

Deciding to Accept a Case

Cases involving aggression directed toward family members involve many factors that should be carefully considered before accepting such cases. In addition to assessing the severity of the aggression problem, the cynopraxic counselor should evaluate the owner's attitude and the general family situation. Are children at risk in the household? How cognizant and responsible is the owner about the potential danger posed by the dog? Can the owner be realistically expected to carry out training procedures and follow through on a long-term basis? What are the odds of a lasting success and management of the problem? Unless the overall picture is one where benefits significantly outweigh hazards, the trainer should decline services and redirect the case back to the referring veterinarian.

If the case is accepted, the owner should be carefully informed of the risks involved, including the fact that long-term treatment outcomes are unknown and, although improvement should be expected and main-

tained, the risk of a future bite incident cannot be entirely eliminated despite the most conscientious and expert training. Currently, a wide range of treatment options exist, often containing conflicting rationales and recommendations with varying degrees of scientific legitimacy and therapeutic value. Voith and Borchelt (1982) observed early on the rather protean nature of the treatment process, stressing that no one technique is likely to work in all situations:

> There are, literally, an infinite number of variations on behavioral techniques for treating dominance aggression … There are no specific techniques that work in all situations. In order to achieve a high rate of success, individual programs that require constant refinement should be designed for each case. There are no inflexible rules on how to respond in specific circumstances. (659)

These observations were written nearly 20 years ago but remain relevant today. At the outset of the training process, owners should be informed that none of the current behavioral protocols used for controlling and managing dominance-related aggression have been rigorously evaluated for efficacy. Despite the absence of definitive studies, preliminary work indicates that a variable therapeutic benefit is achievable in many cases. For example, Uchida and colleagues (1997) performed a follow-up study to evaluate the benefits of an 8-week program of nonconfrontational training on 20 dogs diagnosed with dominance aggression. The follow-up showed that 20% of the owners questioned believed that their dogs had been "cured," while another 30% of them indicated that a "marked improvement" had occurred as the result of the training process. Takeuchi and colleagues (2001) found that 51.2% of owners with dogs exhibiting dominance aggression (N = 82) reported that their dogs showed improvement as the result of behavioral treatment. Reisner and colleagues (1994) reported that 85% of owners with dogs diagnosed with dominance aggression observed some improvement in their dogs' behavior as the result of treatment. Similarly, Line and Voith (1986) found that 16 of 19 owners of dominance aggressors observed improvement, with 13 of them indicating either very much or significant improvement. The extent to which these reports of improvement are attributable to actual changes in behavior due to behavioral training or due to various indeterminate factors such as placebo effect, a desire to please an authority figure, or denial has not been objectively assessed. Given the current state of the art, if pressed for a prognosis regarding a dog with a history of CDA, ethical counselors can only state with confidence that most cases of such aggression can be successfully treated with an expectation of stabilization and improvement, but there is no cure and the risk of future attacks cannot be entirely eliminated. Dog owners must be made acutely aware of these limitations and risks before training is begun.

Treatable versus Untreatable Aggression Problems

Canine domestic aggression presents with a high degree of variability with respect to targets, severity, location, and predictability of attacks. These variables need to be carefully assessed to evaluate the risk of serious injury or permanent scarring to family members (Table 7.2). The target and relative frequency, location, severity, and predictability of attacks determine the viability of behavioral intervention and likely prognosis. Intrafamilial attacks that occur on an unpredictable basis or with minimum provocation pose special difficulties. In cases where severe bites have occurred with little or no provocation or warning, professional training services should be withheld or only cautiously provided, and then primarily to advise the owners about the risks and instruct them on how to avoid eliciting circumstances and to introduce preventive management techniques. Because of the unpredictable nature of the attacks, it is difficult, if not impossible, to assess the benefits of training or to evaluate future risks safely without exposing family members and visitors to a potential bite, thus making such cases by definition "untreatable." Further, in the case of unpredictable aggression, the absence of aggression for some period is no reliable indi-

TABLE 7.2. Aggression ranked in accordance with predictability, frequency, severity, and location of threat or attack

1. Threatening stare and growling
2. Snarling and air snapping
3. Muzzle jabbing and fang whacking
4. Inhibited biting
5. Inhibited biting with bruising
6. Inhibited biting with slight puncture to extremities and torso
7. Inhibited biting with slight puncture to the head
8. Infrequent, but predictable, hard puncture biting delivered to the extremities
9. Infrequent, but predictable, hard puncture biting delivered to the torso
10. Infrequent, but predictable, hard puncture biting delivered to the head
11. Frequent, but predictable, hard puncture biting
12. Infrequent and unpredictable hard puncture biting
13. Frequent and unpredictable hard puncture biting
14. Puncture biting with head shaking and laceration
15. Sustained attacks involving multiple punctures and lacerations

cator that it will not unexpectedly recur at some point (see *Dead-dog Rule* in Volume 2, Chapter 2). Domestic aggression involving severe and unprovoked attacks is often tragically refractory and improvement notoriously transient and labile. Despite the most determined and conscientious training efforts, dogs that bite are at a significant risk for repeating the behavior—a fact that many dog owners eventually forget about over time with disastrous results. Consequently, given the obvious risk to public safety, one cannot rationally justify the treatment of dogs exhibiting severe uninhibited attacks or unpredictable aggression. Dogs exhibiting uninhibited or unpredictable hard biting should be referred to the family's veterinarian for medical evaluation and final disposition. In contrast, treatable CDA is associated with clear warning signals and precursor behaviors, such as direct staring, growling, snarling, and preparatory stiffening, with the dog biting only as a last resort when all else fails to control the situation. When the dog does bite, it is usually inhibited and causes minor trauma, if any. This form of CDA is much more responsive to management and behavior-therapy efforts and has a better prognosis, but it remains technically incurable and its remission depends on a lifelong commitment to management and training.

The absence of a permanent cure and the tendency of aggression to recur may account for the routine euthanasia of dogs diagnosed with dominance aggression. Such a blanket euthanasia policy is inappropriate, however, since many dogs exhibiting CDA can be effectively trained and managed as the result of relatively brief interventions and owner education. In addition, some forms of CDA are significantly influenced by treatable medical conditions that should be excluded before euthanasia is considered. In the absence of medical causes, the decision to euthanize a dog should be based on a formula weighing the severity and location of bites, the frequency and predictability of the attacks, and the composition of household, especially the presence of young children at risk. In addition, a realistic assessment of the owner's ability to carry out training and management recommendations should be objectively considered when faced with such decisions. Unpredictable, frequent, severe bites directed

toward the face or torso weigh strongly in the direction of euthanasia, whereas highly predictable, infrequent, inhibited bites directed to the hands weigh strongly in favor of treatment, at least in the case of homes not occupied by young children. The presence of young children significantly complicates matters, since children are often unable to follow instructions consistently to avoid interaction that might evoke aggression. In homes with young children, dogs exhibiting an established propensity for highly predictable and inhibited aggression toward children should be evaluated for rehoming. Most cases of aggression present with bite patterns that lie somewhere between the opposite extremes of severe, frequent, and unpredictable attacks and infrequent and predictable threats or inhibited bites, requiring objective assessment and evaluation on an individual basis to determine the viability of behavioral intervention.

The diagnosis of dominance aggression is problematic and lacks a universal and coherent set of inclusion and exclusion criteria, with considerable debate and controversy surrounding what is meant by the category. In general, what is referred to as dominance aggression in the literature seems to be deeply and insurmountably confused, representing a significant obstacle to research and the treatment of such problems. The notion of a dominance drive causing a dog to threaten or bite family members in order to achieve a superior rank is particularly problematic, since it is commonly used to justify interactive punishment—a training strategy that is tantamount to treating a burn with hot water. The spectrum of aggressive behaviors linked under the rubric of dominance aggression is more akin to involuntary subordination, social incompetence, reactive impulsivity, powerlessness, and panic rather than social dominance (see *Social Competition, Cooperation, Conflict, and Resentment*). The dominance hypothesis of CDA has not been established convincingly nor is it consistent with the generally obligatory subordinate and dependent nature of the relations between people and dogs. Identifying and controlling resources (e.g., food, affection, and play) of interest to a dog can more easily, rapidly, and safely produce active-submission behavior than force. Setting limits while methodically gratifying submissive behavior (begging) with the contingent delivery of rewards is conducive to the integration of leader-follower cooperation and friendly relations via competent dominance, leadership, and nurturance (see *Filial and Sibling Dominance-Submission Relations*).

Consequently, instead of placing undue and unjustifiable etiological emphasis on a dog's striving to achieve social dominance over the owner as a cause of aggression, cynopraxic treatment programs are better served by reinforcing active cooperation, reducing or removing adverse emotional influences known to lower or destabilize aggression thresholds, and avoiding provocative interaction that might trigger FFS arousal and reactive threats or attacks. Further, instead of emphasizing confrontational and coercive procedures aimed at suppressing aggression or reducing the dog's social rank by force and defeat, training efforts should be dedicated to increasing the dog's social competence by means of reward-based training, with the goal of improving attention and impulse control and shaping prosocial behavior under the influence of dependable prediction-control expectancies and emotional establishing operations incompatible with aggression. In addition to establishing useful control over the dog's behavior, such training efforts serve to mobilize an antistress response, helping to reduce irritability, intolerance, and reactivity, thereby improving the dog's ability to cope adaptively with stressful social interaction (see *Cynopraxis, Antistress, and a Tend-and-Befriend System* in Chapter 6).

Affiliative Conflicts and the Rise of Agonistic Competition

Owner Attitude and Personality, Spoiling, and Anthropomorphism

Owners lacking assertive and confident personalities have been implicated in the etiology of aggression problems. According to Beaver (1999), CDA problems often develop as the result of a mismatch of personality types between the owner and the dog, with timid owners being at a greater risk of falling victim to the aggression of a "dominant type" dog. Hart and Hart (1997) have expressed similar

opinions, suggesting that puppies exhibiting signs of aggression should be "admonished or punished sufficiently so as to subdue the reaction, as long as the owners are safe from being bitten or injured" (1132). Hart and Hart (1985) have also suggested that pampering and spoiling activities play a significant role in the development of CDA problems. Voith and colleagues (1992) have disputed the role of spoiling activities and anthropomorphic attitudes in the etiology of aggression problems. For example, they found that behavior problems (including dominance aggression) appear to occur independently of spoiling activities (permitting a dog to sleep on the bed, giving it noncontingent treats, and sharing food from the table), anthropomorphism, and past obedience training (see *Excessive Indulgence* in Volume 2, Chapter 2):

> Taken together, the results of our analyses clearly and consistently failed to show any support for the notion that dogs that are "spoiled," treated like a person, or not obedience trained are more likely to engage in problem behaviors. In fact, the results … revealed that dogs taken on trips or that received shared snacks or food from the table were significantly less likely to engage in behavior problems. (270)

Although the data linking owner attitudes with the development of aggression problems are sparse and conflicting, some reports suggest that the amount of owner experience with dogs, emotional orientation, and the presence of anthropomorphic attitudes may affect the development and treatment of canine aggression problems (see *Psychological Factors* in Volume 2, Chapter 10). For example, in contrast to the aforementioned findings of Voith and colleagues, O'Farrell (1995) has suggested that owners exhibiting anthropomorphic emotional attachments toward their dogs may be at a greater risk of becoming the target of dominance-related aggression problems; unfortunately, O'Farrell's notion of *dominance* itself appears to be steeped in anthropomorphic assumptions and generalizations about the social functions of dominance and submission behavior. Jagoe and Serpell (1996) found that first-time dog owners are more likely to experience a variety of behavior problems, including disobedience, excessive excitability, and a variety of dominance-related aggression problems. Similarly, Kobelt and colleagues (2003) have linked first-time ownership with reports of increased excitability and nervousness in dogs. Younger owners lacking breed knowledge and experience with dogs appear to be more likely to rear dogs showing aggression and other problems than are older, more knowledgeable, and experienced dog owners (Rugbjerg et al., 2003). Many owners may be fearful of their dog following an attack, making treatment difficult (Manteca, 1998). Some owners appear to be alternately angry or afraid of their aggressive dogs, often leading to disorganized and inappropriate training activities. Relevantly, Dodman and colleagues (1996a) found that thinking-type owners were more likely to succeed in treating dominance-related aggression than were feeling-type owners (see *Psychological Factors* in Volume 2, Chapter 10). Finally, Guy and colleagues (2001b) have suggested that allowing the puppy to sleep on the bed during the first couple months of ownership may be associated with an increased risk of aggression problems.

Dominance, Social Distance and Polarity, and Begging for Love

Among wolves living under natural conditions, the finding, ownership, and distribution of food are important prerogatives of dominance, with active submission representing little more than a food-begging ritual (Mech, 1999; Schenkel, 1967) (see *Wolf Model of Dominance and Submission*). Also, active-submission behaviors and begging for social contact and affection (attention-seeking behavior) are also forms of subordinate behavior, whereas receiving such behavior tolerantly and guiding it into socially constructive outlets is an expression of competent leadership. Submissive seeking is a natural concomitant of reward training and appears to play a significant role in the formation of dominant-subordinate relations resulting from ICT. Setting limits and providing rewards on the basis of a contingency or rule prevents seeking behavior from becoming obtrusive while at

the same time facilitating a VSS. According to this interpretation, the dog is an obligate subordinate, and domestic aggression is most often due to social incompetence developing in association with an ISS, that is, a reactive coping style and preferential responsiveness to signals of punishment and loss. At bare minimum, simply requiring that dogs not become obtrusive while seeking gratification, and that they give their attention to family members by way of submissive "asking" behaviors before they are rewarded, appears be sufficient to maintain subordinate and friendly relations.

In cases where a long-standing history of indulgence and affectionate submission is directed toward the dog by family members (see *Dominance: Status or Control* in Volume 2, Chapter 8), a VSS based on submissive seeking and leadership may fail to develop or may develop in association with significant conflict. In the absence of appropriate social polarity and distance, the dog may show signs of increasing irritability, intolerance, and reactive biting (incompetence) in response to owner interference and intrusion (see *Social Distance and Polarity* in Volume 2, Chapter 8). The excessive affection, handling, and petting given to such a dog may activate nascent dominance dynamics, especially in cases where the dog is given such attention without actively seeking or welcoming it.

Affectionate contact is something that many owners crave and obtain from dogs by means of affectionate solicitation (sweet talk), handling (hugging and picking up), and petting. In an important sense, providing affectionate gratification to family members is a resource that a dog can own and limit access. When affectionate contact is not invited or welcomed, the dog may interpret the family's affectionate efforts as intrusive submissive care-seeking activity rather than care-giving activity; that is, the owner's affectionate contact may be viewed as submissive *begging for love*, to borrow Schenkel's terminology (Schenkel, 1967). This hypothetical reversal of roles associated with affection seeking and giving may generate intolerance, especially with regard to the unwelcome handling and petting provided by least-preferred family members, perhaps triggering the dog's incompetent aggressive efforts to advertise ownership or to set limits on such interaction by threatening or biting them. Retaliation by the owner against such threats may subsequently set into motion an ISS, resentment, and heightened sensitivity to signals of punishment and loss. As the result of unwelcome familial affection-seeking behavior and subsequent punishment in response to the dog's threats, social polarity may be conflicted, with the dog exhibiting behavior toward family members consistent the classical signs of dominance-related aggression. Conflictive dynamics between dominance and submission may be further elaborated and integrated into the relationship by means of incompetent family control efforts (e.g., bribing, cajoling, crouching, repeating, and tricking). Instead of controlling the dog in a confident and friendly way, the owner's control efforts may take on a nervous and begging quality and significance for the dog. By bribing, cajoling, and entreating the dog to cooperate, the owner transfers the locus of control to the dog by allowing it to decide whether to comply. In such cases, the dog appears to reward the preferred owner's submissive asking behavior with compliant tolerance, but may show a lack of responsiveness to less-preferred family members despite their similar submissive strategies. However, regardless of preference, if a family member attempts to force the dog to comply with a stern voice or hand, the dog may actively resist, threaten, or bite hard.

Without identifying and substantially changing the interactive dynamics fostering the development of CDA, it is unlikely that contact aversion, resentment, and propensity for biting can be significantly modified. To promote submissive behavior and a VSS, the family must establish ownership and leadership with respect to significant resources, including the gratification associated with affectionate petting and handling. The key to treating such aggression problems is establishing social distance and systematically reversing social polarity, so that the dog is encouraged to seek affection, play, and rewards from family members while integrating friendly relations with everyone in the household. In

addition to helping the owner understand the problem, an improved relationship based on a balance of dominance, leadership, and nurturance is facilitated by means of ICT. The cynopraxic process is carried out simultaneously on several levels with the goal of providing the owner support, knowledge, practical advice, and a model for more appropriate and friendly interaction with the dog (Table 7.3). Some owners appear to be so emotionally dependent and submissive toward their dogs for affectionate gratification that they accept the occasional bite in order to maintain the relationship. Such owners may also carefully avoid punishing the dog for fear of losing its affection. Such owners of aggressive dogs are also prone to engage in denial and magical thinking about the problem, requiring that the cynopraxist stay on guard for *subterfuge* (protecting the dog by not revealing vital information), *sabotage* (not carrying out the training recommendations), and *slippage* (reverting back to previous patterns of interaction with the dog).

To restore control, such dogs should be appropriately restrained to make them safe to interact with family members. At a minimum, dogs with a history of CDA should be kept on a collar and leash. The dog should be trained to orient on signal (e.g., smooch or squeak). As the dog shifts its attention (target arc), a click or "Good" is delivered and followed by a flick of the right hand to the side. Although, in general, small rewards are preferred, a larger and highly desirable food item can be given intermittently to the dog during the process of training it to approach. As the dog approaches the closed hand, the trainer says "Good" and opens it to reveal the reward. Initially, both the right and left hands are flicked out to the side. The sharp flicking movement of the hand is designed to attract the dog's attention while reducing reactive associations with fast-moving hands. Feeding the dog by hand is a viable way to restore confidence and reduce potential adverse associations associated with past rough handling or hitting. The hand should be flicked to the side, not toward the dog. In addition, a scented squeaker bulb can be held in the hand and gently squeezed (without squeaking) to deliver the dilute scent of orange or lavender just before the hand is opened. Tactile-target-arc training can be performed by getting the dog to orient to a gentle nonthreatening touch followed immediately by the conditioned odor alone or combined with the squeak or smooch sound. Such training appears to help integrate new sensory associations and input at the level of the sensory analyzer and gating channels leading to higher cognitive and emotional processing.

Gradually, the dog is required to look into the trainer's eyes for variable periods before the trainer says "OK" and flicks the right hand to the side, thereby causing the dog to break eye contact. The dog's name can be paired with the orienting signal and the vocal

Table 7.3. Elements of cynopraxic mediation and counseling

Respond sincerely and sympathetically to the owner's concerns about the dog's behavior.
Emphasize the positive aspects of the relationship and constructively frame the problem in the context of achievable goals.
Provide an authoritative and objective evaluation of the problem in both functional and interpersonal terms.
Discuss and clarify the dog's biobehavioral needs and provide practical ways of satisfying them.
Discuss possible social and environmental causes contributing to the problem.
Introduce scientifically sound behavioral principles for understanding and controlling or managing the problem behavior.
Demonstrate cynopraxic training procedures, stressing the importance of predictable and controllable training events to promote comfort, safety, and trust.
Provide the owner with a positive role model for interacting with the dog.

signal "Come" can be overlapped with the approach. These components are foundations that all family members can practice with the dog. Children are instructed to avoid directly approaching the dog, but may use the foregoing procedure in an abbreviated way (e.g., dog's name, smooch, flick the hand, "Good," and food reward) to encourage the dog to approach or follow them. Approximately half of the dog's daily ration should be fed by hand, with the dog approaching the child and the parent from various distances. The orienting, frontal approach, and sustained attending responses systematically integrate the social engagement system, serving to establish highly predictable and controllable interaction that is emotionally incompatible with aggression. As things progress, the dog will become more approachable and receptive to contact as the scripting of friendly roles and expectancies of reward are established. Training the dog to approach is an extremely useful procedure for changing the direction of attention and social polarity and managing potentially provocative situations. In situations where the dog shows signs of arousal, the trainer can back away and trigger the orienting response, bridge it, and perform the flick signal to bring about a friendly resolution of the conflict. Initiating cutoffs, integrating alternative behaviors incompatible with aggression, and performing a reconciliation ritual can be helpful in the management of many CDA problems (see *Loss of Safety, Depression, Panic, and Aggression*).

An adaptive coping style and VSS are further facilitated by means of shaping (see *Shaping: Training through Successive Approximations* in Volume 1, Chapter 7). The procedure offers many significant benefits in the training of dogs showing adjustment problems associated with social incompetence and a reactive coping style. Shaping procedures are highly beneficial in this regard because they explicitly shift the locus of control over significant events (reward and punishment) from the trainer's initiative and prompting to the voluntary initiative and experimentation of the dog. Excessive reliance on command-and-response training may foster an undesirable continuation of dependency on the owner for obtaining comfort and safety, perhaps merely complicating the situation with another layer of behavioral entrapment and loss of freedom. Consequently, in addition to structured ICT and attention therapy, strong emphasis is placed on rewarding constructive initiative (offered behaviors) and active participation via shaping and play. Shaping is eminently compatible with cynopraxic training and therapy objectives (see *Prediction Dissonance and Shaping* in Chapter 10). During the shaping process, the dog's behavior is intensively differentiated and organized in accordance with the formation of instrumental prediction-control modules, calibrated appetitive and emotional establishing operations, and emergent adaptive modal strategies. As a result, shaping provides a potent source of somatic and cortical reward in the process of developing socially adaptive control modules and modal strategies. In addition to learning new behaviors, already established basic obedience modules and routines can be retrained by breaking them down into approximate components and steps for the dog to learn via the shaping. Offered responses need not precisely match the trained module or routine to warrant reward, but can be taken as a starting point for shaping. By waiting and giving the dog a fair chance to offer an appropriate behavior or learn to experiment without risk of punishment, the dog's sense of control, competence, and confidence is gradually improved and its trust enhanced. Patiently waiting and rewarding offered behavior or providing supportive guidance during the shaping process helps to improve the owner's leadership skills while increasing the owner's appreciation of the dog as learner.

Nothing in Life Is Free, Subordinate Postures, and Rank

During the 1970s, Voith (1977) explored the possibility of treating dominance-related CDA by means of a reward-based training protocol. Historically, this was a significant departure from earlier training methods based on the force-based concept of wolf and dog dominance hierarchies popularized in the writings of Lorenz (1955). Believing that CDA was primarily the result of dominance incentives operating within the household, she explored the possibility of altering the status of domes-

tic aggressors by reinforcing subordinate postures (e.g., sit, lie down, and roll over) with food and a variety of everyday rewards (petting, play, opportunities to go outside, and so forth) in accordance with a "nothing in life is free" (NILIF) program. Once the dominance hierarchy was reversed by means of NILIF and graduated exposure to mildly provocative handling, owners were instructed to counteract growling and other threats by moving back and staring the dog down from a safe distance (Voith and Borchelt, 1982):

> Establishing the maxim that "nothing in life is free" is a means of subtly reversing a dominance hierarchy by requiring the dog to assume progressively more submissive postures before it gets anything it wants. If the dog indicates it wants to be petted, to go out, to come in, or to play, it must, for instance, sit before it is allowed to engage in the activity. Later, it may be requested to lie down, roll over, or gradually tolerate pressure on its back or muzzle before it is permitted access to what it wants. (659)

The NILIF program has been applied in various ways to treat dominance-related aggression and other common behavior problems. Despite its widespread use, scant research has been performed to test the hypothesis that positive reinforcement of submissive postures can help to reverse an established dominance hierarchy. Tortora (1980) reported some data obtained from a case study in which submissive behavior was selectively rewarded in an effort to reduce aggression in an 18-month-old bullmastiff. The dog exhibited a variety of aggressive behaviors toward family members and attacked several persons not belonging to the household, including a severe attack resulting in 11 stitches to one of the victims. The treatment program consisted of first reinforcing various submissive facial expressions and then shaping a progression of bodily postures leading to the dog rolling on its back and allowing the owners to put their hands around the dog's neck. Each facial expression and posture was prompted and paired with the vocal signal "Quiet." The rewards given to the dog consisted of attention and kibble. The submission training was carried out daily over the course of 20 days, with the dog reportedly showing a dramatic reduction of threatening behavior. The improvement was still evident after a 6-month follow-up, despite inconsistent training efforts by the owners. Unfortunately, the significance of the foregoing case study is difficult to assess since the owners performed the procedures and collected the data. Further, given the severity of the problem and the owners' evident lack of behavioral experience, one cannot help being skeptical about the success reported. Such miraculous improvements are relatively rare in the process of working through serious aggression problems and, in any case, they are the exception rather than the rule. Whether it worked or not, conventional basic obedience procedures incorporate a similar but more systematic and controlled approach to prompting and rewarding compliance and submissive postures in the context of basic training. Combining reward-based training and various behavior-therapy procedures (response prevention, graduated interactive exposure, counterconditioning, TO, and so forth) with a modified NILIF program, integrated compliance training, directive prompting, mechanical manipulation (e.g., PFR training), escape/avoidance training, and play, selected and organized to match the needs of the dog, would seem to offer the needed flexibility and variability to respond to the individual differences and training requirements of the greatest number of dogs.

Other authors have questioned the ability of the NILIF program to reverse established dominance relations. Reisner (1997), for example, has expressed general doubts about the efficacy of behavioral efforts to reverse the household dominance hierarchy, but argues that "altering the dog's perception of rank order should be possible, if only in mild cases, so that conflicts are less likely to occur" (487). The idea that one might be able to alter a dog's perception of rank order without at the same time modifying its actual rank seems to be an extraordinary proposition. Logically, a hierarchical change in dominate-subordinate relations ought to occur before the dog's perception of rank order is modified, for what else other than such an actual change might

sensibly explain the dog's altered perception of rank? Perhaps the statement refers more loosely to changes in interaction that alter the dog's perception of the social rank of family members without necessary changing its rank. In either case, the attribution of causal and therapeutic significance to hypothetical changes made to a dog's perception of rank order without changing its actual rank seems to exchange a difficult-to-prove dominant-rank hypothesis for an even more difficult-to-prove dominant-attitude or *perception-of-rank* hypothesis that is fraught with anthropomorphic pitfalls, potential for attributional error, and risk for pseudoscientific fictionalizing (see *Social Dominance: Dispositional Cause or Attributional Error*). Both of these social dominance notions contain etiological assumptions that are taken for granted as facts instead of unproven hypotheses or, worse yet, untestable beliefs.

In any case, Reisner contends that keeping the dog off furniture and not allowing it to jump up during greetings serve to modify its perception of rank order since "height inflates social rank" (488). The owner is also instructed to forbid the dog from entering the bedroom at night in order to prevent the dog from laying "claim to the owner's resting place" (488). The owner is warned to keep the dog away from the table and to feed it only after the family has eaten, apparently based on the assumption that the alpha eats first and so on. These various assumptions concerning dominance and the dog's perception of rank are problematic and difficult to defend. Interpreting human-dog interactions in terms of wolf social behavior is risky even when it is founded on accurate and complete ethological information. Although a dominant wolf may stand over a cowering subordinate (Van Hooff and Wensig, 1987; Mech, 1999), and such height differences may signify rank in the context of active threat and appeasement exchanges, to my knowledge there is no significant evidence supporting the idea that wolves or dogs advertise rank by claiming and defending elevated places or that they preferentially select such places for an advantage with respect to asserting control over group members. Many perfectly subordinate dogs enjoy resting on furniture, sleeping on beds, taking treats from the table, and affectionately jumping up at greetings under the influence of attention-seeking and comfort-seeking incentives, without ever feeling an urge to threaten or bite family members. Such dogs may become obtrusive and irritating nuisances needful of training, but they rarely show aggression problems or become confused about their social rank. Voith and colleagues (1992) "clearly and consistently" failed to detect a relationship between allowing a dog to engage in the previously mentioned activities and an increased risk of developing behavior problems, including aggression toward family members. The suggestion that feeding the dog second may be helpful to reduce dominance-related problems also appears to be without support; in fact, such a change in feeding order may actually risk increasing aggressive behavior. Jagoe and Serpell (1996) found that deferring the dog's meal until after the family had eaten was positively correlated with an increased risk of territory-related aggression. Dogs that show threats when approached while on furniture or while occupying any other place in the house should be thoroughly desensitized to the owner's approach and trained to jump off furniture on signal and to refrain from getting back up unless invited up first. Also, dogs that have shown overt aggression while on beds should be repeatedly prompted to get on and off the bed until the response is performed fluently and without hesitation. All compliance training should be performed with positive reinforcement in conjunction with minimal leash prompting and brief TO, as needed to de-arouse the dog. Once trained, the dog should be permanently forbidden access to the bed, not because it might engender a misperception of the owner's rank, but simply because it reduces the risk of an aggressive event in the future. Since a significant correlation has been detected with respect to intrafamilial aggression and cosleeping during the first two months after coming into the home (Guy et al., 2001b), puppies should be prevented from sleeping on the bed during the first 2 or 3 months. Finally, as regards jumping up, such behavior is typically

aimed at achieving close contact, intensifying tactile stimulation, and promoting friendly relations. Even when sociable dogs are greeted by crouching down, the owner does not risk losing rank, but rather invites affectionate licking, nudging, and pushing-in behavior and other active-submission behaviors. According to Schenkel (1967), among wolves such behavior may be interpreted as an "overwhelming offer of friendly affection" (324). When crouched down below the dog's eye level, few dogs will attempt to take advantage of the situation in order to advance their status; however, many may be prompted by the action to play, appearing to interpret the lowered posture as an invitation to play (see *Metacommunication and Play* in Volume 2, Chapter 8). Such interaction would be inappropriate and potentially dangerous in the case of an experienced aggressor simply because it places the trainer in a vulnerable position and exchanges an increased risk for a minimal potential benefit—not a wise training decision. Jumping up can become an obtrusive and unwelcome habit if appropriate limits are not set on it, but prompting a friendly dog to jump up is unlikely to adversely affect its perception of rank or promote aggressive behavior.

To further adjust the dog's perception of rank and increase owner control, Reisner (1997 and 1998) recommends an abrupt cessation of all affection and other sources of reward for 2 weeks, during which time family members are instructed not to speak to the dog, pet it, or show it affection. The dog is totally ignored except as necessary to meet its basic needs. During the next 2 weeks, attention and affection are partially restored, but only at the owner's initiative. All attention is given on a contingency basis, requiring that the dog first submit to an obedience command. The dog is only permitted to ask for attention after a month of social deprivation, and then attention is provided contingently on half of the occasions in which the dog solicits it from family members. All rewards are provided on a contingency basis, such that the dog must sit or lie down before being petted, given food and treats, taken for walks, let outdoors, and so forth. Finally, outdoor activities are severely curtailed by exercising the dog on leash, and ideally all off-leash romping in the yard is eliminated. The NILIF program, together with the previously mentioned prohibitions, is embedded into every significant social transaction for the remainder of the dog's life so that family members can dictate control over the dog's "daily decisions." The NILIF process, as described by Reisner, appears intended to externalize the locus of control and thereby undermine the dog's ability to initiate independent actions in search of reward. As such, the program appears to promote an increasing social dependency and powerlessness, whereby the owner dictates what the dog can do and when it can do it while frustrating the dog's ability to produce social reward on its own initiative.

Ironically, although extreme forms of positive punishment have been rightly repudiated, many of the same individuals who admonish dog owners not to use physical punishment show little compunction about hanging the dog out to dry. Whether intended as such or not, the withdraw of social reward is a highly stressful and anxiogenic form of punishment, indiscriminately targeting both desirable and undesirable social behaviors irrespective of what the dog does or does not do. Although both forms of extreme punishment are problematic and deserving of criticism, at least positive punishment is usually applied contingently against a specific target behavior. In contrast, the social-deprivation procedure punishes all social behavior with *inescapable* nonreward, disconfirming previously established prediction-control expectancies, and thereby generating considerable distress and confusion. If the social-deprivation procedure works to reduce aggression, it probably does so by inducing increased social anxiety and psychological stress via a variant form of learned helplessness induced by the abrupt and inescapable loss of control over social rewards (see *Learned Helplessness* in Volume 1, Chapter 9).

Abruptly depriving the dog of basic social and appetitive needs that had have routinely provided for in the past is a provocative shift of social and environmental expectations, potentially exerting a number of problematic

side effects. Social isolation and restraint stress have been shown to increase anxiety and lower reactive thresholds among dogs and laboratory animals (see *Restraint, Unavoidable Aversive Stimulation, and Stress* in Chapter 10). Among rats, brief or acute restraint stress appears to exert an inhibitory effect on aggression, whereas exposure to chronic restraint stress causes rats to become significantly more threatening and hostile toward cagemates. Over the same period (14 to 21 days), nonstressed controls tended to form more friendly and stable relationships, showing significantly less aggressive behavior toward cagemates and no evidence of fighting by the end of the study period (Wood et al., 2003). While brief cold shouldering may pique a dog's interest in social rewards and increase its efforts to restore rewarding exchanges with family members, chronic social deprivation and confinement may risk activating dispersive tensions and entrapment dynamics, perhaps causing domestic aggressors to become increasingly unstable, incompetent, and confrontational around safe havens perceived as under threat.

The chronic stress associated with the social-deprivation procedure may generate a significant challenge to the dog's coping capacities and behavioral integrity, probably increasing its dependency while further reducing its ability to competently initiate and organize social behavior, impeding its ability to learn efficiently, and thwarting the *attentionis egens* mediating positive human-dog affiliation (Odendaal and Meintjes, 2003). The noncontingent loss of control over appetitive and social rewards, the disruption of daily social routines, changes in the demeanor and behavior of significant others, forced exclusion from significant family activities, increased interference and social thwarting around familiar places associated with comfort and safety, noncontingent rebuffing and snubbing of affection and contact seeking, increased social control and restraint, and entrapment (the dog cannot simply leave the situation) may exert significant depressive or aggression arousing and disorganizing cognitive, emotional, physiological effects, depending on individual differences expressed by the dogs treated with the social deprivation procedure. Although the procedure may temporarily reduce reactive aggression in some cases via increased anxiety and depressive inhibitory effects (m-type dogs), relatively fearless dogs with low-to-medium anger thresholds and intolerance for frustration (c-type dogs) may be more adversely affected by such stressful household changes.

As emphasized previously, the vast majority of intrafamilial aggressors appear to be socially incompetent and anxious dogs exhibiting a reactive coping style and ISS acquired in association with social interaction failing to support a secure and trusting bond. Social interaction lacking orderliness and consistency is productive of varying levels of anxiety, frustration, and conflict (see *Neurosis and Conflict* in Volume 1, Chapter 9). Instead of relating to family members in a proactive and adaptive way in anticipation of reward conducive to comfort and safety, the dog may become progressively vigilant for signals of punishment (loss of comfort and safety) and reactive. In addition to reducing the dog's ability to form a secure bond with family members, poorly organized interactive reward and punishment may disrupt the dog's ability to organize optimistic expectancies and active modal strategies needed to produce cortical rewards (positive prediction error). As a result, such dogs may exhibit a negative cognitive bias toward interaction with family members, appearing to expect the worst to occur as the result of social contact. These dogs appear on guard and vigilant for signals of punishment (anticipatory anxiety), often exhibiting an extreme intolerance for frustration or discomfort, and a heightened readiness to cope reactively by threatening (conflict) or attacking the owner in response to relatively innocuous social intrusion and interference.

In other cases, the social environment may be relatively orderly, but the dog may not be able to properly experience it as such. Many domestic aggressors appear to view the success or failure of their interaction with family members as something determined by external causes that are largely outside of their voluntary initiative to control. To borrow Rot-

ter's terminology (Rotter, 1966), *externals* place the locus of control over events critical for their comfort and safety beyond their ability to produce or avoid them (see *Locus of Control and Self-efficacy* in Volume 2, Chapter 9). For example, overly dependent dogs may come to view rewarding interaction with family members as something that happens to them rather than something that they make happen for themselves as the result of cooperating successfully with others. As a result of acquired incompetence, such dogs may lack confidence and show high levels of social anxiety in situations that require independent initiative and choice. Externals tend to react to situations rather than adapt to them, and they may not learn very much of benefit from the consequences produced by their reactions. When exposed to increasing pressure, they tend toward extremes of increased motor impulsivity (c type) or immobility (m type). Such dogs may exhibit a number of serious aggression problems, the nature of which depends on reactive (anger and fear) thresholds and allostatic load. Reactive aggressors often show signs of an insecure attachment (neediness), often forming an overly exclusive attachment with a particular family member with whom they may feel relatively comfortable and safe or ambivalent but not aggressive. Such dogs are often diagnosed as dominance aggressors, but are probably better understood as socially incompetent aggressors operating under the influence of a reactive coping style and ISS (see *C-type and M-type Affinity for the Flight-Fight System*). Instead of viewing family members as sources of calming affiliation and reward, such dogs may experience social interaction as intrinsically stressful and productive of anticipatory anxiety and aversion (resentment). Such dogs may show significant conflict with regard to affectionate interactions, appearing to invite contact, but then turn and bite hard without provocation. The dog may allow a family member to pet its head or to rub its belly before the dog unexpectedly delivers a hard bite. Even during affectionate episodes of kissing, dogs have delivered severe and disfiguring bites to the face of loving victims. These dogs may become progressively intolerant toward social contact, especially in certain areas (site-dependent attacks) associated with comfort and safety. When disturbed while in these locations, such aggressors may react to slightest interference as a provocative cost or threat to their island of security.

Canine polymorphic variations affecting anger and fear thresholds, ontogenetic adversity (e.g., prenatal and postnatal stress), problematic socialization and training, and a compromised capacity to experience reward may predispose dogs to acquire an ISS and exhibit aggression toward family members. However, the incompetent intrafamilial aggressor rarely develops without the abetment of an inexperienced or inept leader, lacking the necessary dog savvy, skill, or desire to properly socialize and guide the predisposed dog toward social competence and independence. Pushed to extremis by interactive conflict, mishandling, and entrapment, such dogs may become progressively insecure, reactive, and dangerous. Instead of punishing and further agitating the household aggressor with stressful deprivation procedures that will only serve to further externalize the locus of control, increase the dog's dependency, and perpetuate its incompetence, an opposite strategy is typically adopted whereby contingent reward opportunities are hugely increased in the process of organizing mutually gratifying and bond-enhancing interactions between the dog and family members. The goal of such training is to organize a proactive or adaptive coping style and to encourage interaction conducive to a friendly and cooperative VSS. According to this perspective, building a mutually rewarding and trusting relationship between family members and the dog is the best way to forestall intrafamilial aggression. An important step toward this goal is teaching the dog *how to competently operate family members* to produce somatic and cortical rewards, that is, helping the dog to internalize the locus of control over rewards and to patiently enhance its self-efficacy and mastery by means of cynopraxic training. In an important sense, the goal of such training is to increase the dog's competence, confidence, and independence, that is, to train it to

become more dominant, relaxed, and effective with respect to the gratification of its needs.

In the process of organizing an adaptive coping style, an opioid-oxytocinergic antistress system may be activated to further support bond-enhancing neurobiological and physiological changes incompatible with aggression and anxiety. In addition to increasing affectionate interaction and reward availability, a quality-of-life assessment is performed to optimize exercise, playful interaction, household liberty, and so forth. Interactive conflict and tensions are traced to their sources and converted by means of ICT into situations of potential reward, providing a foundation for mutual appreciation and interactive harmony. A spirit of tolerance, fairness, and optimism should permeate the cynopraxic therapy process, with family members and the dog gradually *joining up* to interact more competently and confidently toward one another in accord with an emergent adaptive coping style, affectionate and playful dynamic modal relations, and the integration of harmonic social relations and roles via a VSS. Instead of perpetuating a heightened vigilance (anticipatory anxiety) for signals of punishment and a readiness for aggressive confrontation, cynopraxic therapy aims to increase the dog's alertness and preparedness for signals of reward by increasing leadership and interaction leading to enhanced comfort, safety, and relaxation (somatic reward) and better-than-expected outcomes (cortical rewards) in association with cooperative transactions. The integration of positive prediction error and surprise teaches the dog to anticipate something positive from the unexpected rather than bracing with anticipatory anxiety for something negative to occur. The cortical reward associated with positive prediction error appears to play a critical role in reorganizing prediction-control expectancies and modifying executive control over aggressive impulses. In general, rather than attempting to suppress aggression by means of physical or psychological domination tactics, the cynopraxic therapy process is carried out in conformity with the dead-dog rule and is oriented toward forming a playful and friendly bond based on mutual trust, affection, and joy.

Limit-setting Actions, Basic Training, and Friendly Cooperation

Organizing functional boundaries between owners and aggressive dogs is based on setting social limits and systematically structuring rule-based interaction through ICT. Although the value of basic training for preventing aggression problems has been questioned (Voith et al., 1992), many authors have noted a beneficial effect on both the incidence of behavior problems and the quality of the human-dog bond following basic training (Blackshaw, 1991; Clark and Boyer, 1993; Jagoe and Serpell, 1996; Goodloe and Borchelt, 1998) (see *Role of Integrated Compliance and Obedience Training* in Volume 2, Chapter 6). Whether obedience training exerts a preventive benefit probably depends on the quality of the training provided and the reliability of the control established, with the dog's ability to follow commands being negatively correlated with the occurrence of behavior problems (Kobelt et al., 2003). Training the dog to defer to social limits and obey promotes a cooperative attitude conducive to effective communication and friendly social interaction. Most dogs exhibiting aggression problems benefit from the introduction of reward-based basic training and the shaping of cooperative behavior. It is not enough to explain to an owner what to do, but, more importantly, the owner must be shown how to do it. Establishing dominance is not just about setting limits, but rather, as J. H. Woolpy (1968) has well stated, "some as yet poorly understood personality factor seems to have the greatest sway" (46). Accomplished trainers not only instruct owners on procedural details, they personify the essential "personality factor" alluded to by Woolpy via subtle and gross body language, vocal expressions, personal presence, and sincerity of purpose. These nonverbal impressions are extremely useful for helping owners to establish an affectionate and healthy interactive relationship based

on social limits, rules, and cooperative expectations. Presence and sincerity of purpose are the hallmarks of master trainers. Basically, such an attitude simply and confidently states without threat or doubt a presence of control. Social dominance is about establishing control, but more than anything else dominance depends on the projection of an attitude characterized by confidence and sincere purpose. Teaching owners how to succeed with their dogs and to avoid aggressive episodes improves their ability to project a confident attitude. Training and behavior-therapy efforts will yield little lasting benefit if the owner remains a victim in attitude toward the dog.

Problems associated with CDA do not emerge spontaneously like a fully armored Athena leaping from the head of Zeus, but gradually becomes serious over time (Takeuchi et al., 2001). CDA problems can often be traced to early ontogenetic influences involving affiliative conflicts. Adult dogs exhibiting domestic-aggression problems were frequently excitable, emotionally reactive, and difficult-to-control puppies (Guy et al., 2001b). Such puppies appear learn at an early age that their owners can be manipulated with threats, sharp teeth, and claws. In addition, puppies at risk are often hyperactive, aggressively possessive (growl and snarl) over food and toys, competitive and reactive to normal discipline, habitually steal and guard forbidden items, resist routine grooming and handling, engage in excessive and persistent mouthing, and may be reactive to physical restraint. Predisposed puppies may react aggressively to being placed into a down position or held there by force, but willingly lie down for a treat. As the result of a failure to establish appropriate limits and social distance (dominant-subordinate relations), the situation may become progressively unstable and rife for serious competitive contests. While this general competitive pattern is common, not all puppies exhibiting the foregoing behavior patterns go on to develop aggressive behavior as adults. Further, in some atypical cases, the aggressive dog may exhibit few or none of the aforementioned early indicators of risk.

Diversion and Interruption versus Punishment

Although punishment (e.g., time-out) can be effective in some situations involving control-related aggression, caution is advised whenever contemplating the use of physical punishment to handle growling and other threat displays. Recommending that a dog owner punish growling is highly questionable and makes little sense in the context of cynopraxic therapy efforts. Low-grade threat displays provide the trainer and others with a margin of safety and warning while interacting with the dog. Suppressing the growl is extremely easy to achieve, but nothing is gained by the effort since it is unlikely to alter the dog's motivation to bite in a way that fosters behavior incompatible with aggression. In managing aggressive dogs, threat behavior should be reduced by means of positive behavioral and emotional changes taking place as the result of establishing an adaptive coping style and reward-based training. The absence of threat displays should indicate the absence of aggressive arousal and intent, not the development of a far more dangerous situation in which the dog remains aggressively aroused but has learned to inhibit threat displays without reducing its propensity to bite (see Species-typical Defensive and Offensive Aggression). Consequently, instead of punishing the growling response, a better approach is to acknowledge the threat by moving away or by evoking a diversionary establishing operation aimed at encouraging behavior incompatible with aggression (see Establishing Operations in Chapter 1). The dog can be diverted from aggressive arousal by various means, including picking up a toy, going to a door and acting like a walk is in the offing, or tossing a treat, with the goal of evoking submissive seeking behavior for the activity or resource. The procedure follows the principle that active submission is established by evoking an appetitive- or social-seeking response that is subsequently rewarded in exchange for cooperative behavior and voluntary subordination (affectionate submission). Directly punishing threatening behavior is prone to produce aggressive reprisal or result in involuntary subordination with resentment and fear.

Moving away from the dog may reinforce the growling behavior, not an entirely desirable outcome, but one far better than suppressing it. Dogs encouraged to growl and threaten are probably at a reduced risk of biting without warning and, having learned that growling works with minimal risk of retaliation, such dogs may be more inclined to limit their aggressive control efforts to such threat displays rather than escalating to overt attacks when they become aroused. The second method (changing the motivational state) typically involves throwing the growling dog a highly prized food item, causing it to shift from a threat-producing mode to food-seeking mode. As the dog's attention turns to the food, it is more likely subsequently to offer behaviors incompatible with aggression, especially in cases where compliant behavior has been reinforced with food in the past. Habitually walking away from a growling dog to get some treats (situation change) and coming back to throw the dog a treat (motivational change) may help significantly to diffuse aggressive tensions associated with that specific trigger situation, especially if the dog is caused to beg and perform a simple exercise or two to obtain subsequent treats. In some cases, merely having the dog repeatedly orient to the sound of a squeaker or smooch followed by a click and the presentation of food can help to shift the dog rapidly from a threatening to a cooperative mode of interaction. The foregoing technique is most effective following several days of intensive preliminary attention training with sit, sit-stay, following, and recall training.

In contrast to the reinforcement that may follow if the trainer walks away from a growling dog, there is little likelihood of inadvertent reinforcement of aggressive behavior occurring as the result of giving the dog food as a diverter at such times, especially if rewards subsequent to the initial presentation (diversionary establishing operation) are made contingent on behavior incompatible with aggressive threats (orienting response, sit-stay, come, and so forth) (see *Interrupting Behavior* and *Diverters and Disrupters* in Chapter 1). Since the goal of threat behavior is the imposition of social or physical space between the owner and dog—not the acquisition of food—the introduction of food at such times is rather irrelevant with respect to the immediate goals of growling; however, in the unlikely event that the dog learns to growl as a way to get food, such growling is of an entirely different motivational significance and order. In such cases, growling for food is an innocuous trick performed under the influence of appetitive incentives and seeking behavior, which signifies something quite different from the growl advertising an imminent threat of overt attack. The appetitive activation of the seeking system appears to exert a potent inhibitory effect on the emotional command circuits mediating the expression of aggression (see *Drive Systems, Aggression, and Behavior Problems* in Chapter 6). In addition to tossing the dog a treat, a diversionary odor that has been previously conditioned with food or play (e.g., a scented squeaker or ball) or relaxation can be introduced at such times as a means to divert the dog's attention and to modulate aggressive arousal. A squeaker containing a wad of orange-scented cotton can be highly effective as a diversionary stimulus, especially if it has been previously conditioned and used as an orienting stimulus in the context of attention training.

Anger, Restraint, and Frustration

Aggressive behavior is intimately associated with emotional antecedents that prepare dogs for aggressive action, especially anger and rage. Anger can be elicited by painful stimulation and physical restraint, but it is also associated with the anticipated loss of valued objects or activities via frustration (Dollard et al., 1939; Berkowitz, 1989). Dogs exhibit varying degrees of tolerance for pain and restraint, with the vast majority of well-socialized and habituated dogs appearing to cope extraordinarily well with mild pain and physical restraint, and rarely showing aggression in response to such stimulation except under circumstances of extreme duress and discomfort. However, some dogs are highly reactive to pain or the threat of painful stimulation, exhibiting

a low threshold for discomfort and restraint. Under the influence of minimal restraint or discomfort, such dogs may struggle violently and attempt to bite in an effort break free. The way dogs respond to restraint and other forms of aversive stimulation depends on genetic and acquired influences affecting behavioral thresholds (Scott and Charles, 1954).

Prominent emotions associated with pain and restraint (loss of freedom) include fear, irritability, frustration, and anger. When pain and restraint are simultaneously produced, escalating fear and anger may be elicited and coalesce into a state of panic and rage, building dramatically and violently until the animal either breaks free or is exhausted. If biting and clawing are successful as the result of such struggle, such behavior will be more likely to occur under similar circumstances of painful restraint in the future. In addition, signals of punishment anticipating painful stimulation and restraint may become conditioned elicitors of fear and anger, resulting in preemptive efforts aimed at avoiding such stimulation. The simultaneous elicitation of conditioned fear and anger by the same social object that otherwise is associated with affiliative comfort and safety may represent a significant source of emotional conflict and anxiety. This general scenario is common in cases involving interactive punishment and reactive aggression.

Repeated exposure to restraint and inescapable aversive stimulation is highly stressful and productive of behavioral disturbance (see *Liddell: The Cornell Experiments* in Volume 1, Chapter 9). In addition, frustration associated with restraint (thwarting the freedom reflex) and loss of control over aversive or attractive events may activate anger/rage circuits. The function of anger is to motivationally intensify defensive behavior, preparing dogs to respond with aggression, if necessary, to successfully prevent the loss of some resource or to control (avoid or escape) an aversive event. As such, anger is adaptive and useful for controlling adverse environments. The evaluation of success and failure with regard to the control of attractive and aversive events entails the existence of significant cognitive processing, whereby the expected outcomes of actions can be compared with what actually occurs. Assessing outcomes and adjusting behavior to fit those assessments takes place at an executive level of organization, probably localized in the prefrontal cortex. The prefrontal area performs a variety of attention and impulse-control functions, modulating the expression of emotional behavior and mediating organized social behavior and learning. Prefrontal deficits are associated with a persistent failure to organize behavior appropriately in accordance with consequences. Under conditions resulting in the stressful habituation of the orienting and attending response (e.g., unpredictable and uncontrollable stimulation) (see *Locus of Neurotogenesis* in Volume 1, Chapter 9), a dog's ability to appraise behavioral output and organize behavior in an adaptive manner may be significantly disturbed. Actions associated with prefrontal disturbances are characterized by hyperactivity, impulsiveness, and immediate gratification. Prefrontal deficits may predispose dogs to exhibit intolerance for frustration and restraint and a resistance to inhibitory training, as well as showing an increased tendency to react to such stimulation with impulsive adjustments, including aggression.

Since the prefrontal area is highly sensitive to stress and prone to disturbances associated with stress, therapeutic efforts in such cases should involves steps to normalize function by reducing sources of environmental and social stress. In addition, various activities enhancing the dog's ability to cope with stress should be introduced and emphasized in advance of the implementation of more intrusive efforts (e.g., withdrawal of social attention). Areas of particular importance in this regard include exercise, play (as safe and appropriate), avoidance of aggression-provoking situations, graduated massage [posture-facilitated relaxation (PFR) training], reward-based training, and the avoidance of provocative punishment. Training a dog to orient and hold its attention on the trainer while performing various basic obedience exercises is a useful way to enhance impulse control and promote organized behavior. Linking the orienting and attending response to the occurrence of highly predictable and

controllable events in association with basic training gradually serves to restore the appraisement and organizing functions of attention. In the case of highly stressed and reactive dogs, selective serotonin-reuptake inhibitors (e.g., fluoxetine or paroxetine) are commonly prescribed, perhaps producing a complementary effect on prefrontal executive normalization when given in conjunction with attention therapy (see *Pharmacological Control of Aggression* in Chapter 6).

Behavior Therapy and Training Procedures

Managing Aggressive Dogs

While the owner is most concerned about eliminating the threat of biting as quickly as possible, the trainer's goal should be to steer the owner's attention toward a better appreciation of the causal factors underlying the dog's biting problem and from there to develop an appropriate program of management, behavior therapy, and training. Effective management involves the introduction of various techniques for reducing adverse environmental stressors and emotional influences. Perhaps the most important goal of management is to teach the owner how to interact safely with the aggressive dog by taking precautions and using appropriate restraint strategies. The sort of management needed depends on the severity and frequency of the aggressive behavior. Dogs with a history of CDA should be kept on a leash whenever around family members at risk. In some cases, a muzzle or halter should be used for added protection, especially in the case of aggressors with a confirmed history of biting. The muzzle or muzzle-clamping halter should be introduced gradually with loads of positive reinforcement to encourage a relaxed acceptance of the restraint. Despite such preliminary efforts, some dogs may never relax while wearing such devices and may exhibit adverse side effects that limit their usefulness (Figure 7.3). The temptation to punish a dog while it is wearing a muzzle or muzzle-clamping halter should be avoided. Such treatment is highly problematic and probably does little or nothing to reduce the risk of aggression when the dog is not so restrained, but may, in fact, make the dog more apprehensive and more determined than ever not to integrate friendly relations with the owner. Punishing a muzzled dog is contrary to the trust-building objectives of cynopraxic therapy and should be avoided. Instead of using the advantage of muzzling to punish the dog, the goal of such restraint is to enable to owner to safely interact in close quarters with the dog without risking an attack. Such restraint provides response prevention, thereby showing the dog that its aggressive behavior is not necessary. Every effort should be made to make the dog feel safe while it is muzzled or wearing a head halter. In some cases, aggressive dogs should be crate trained and learn to accept confinement in other places, as well, without making a disturbance (e.g., confinement in a locked bedroom when guests visit). All interaction with people should be carefully supervised, and persons at risk of making contact with the dog should be warned of the dog's propensity to bite. All social interaction should be managed and structured to promote safe and friendly exchanges. The control of CDA stresses training efforts designed to minimize the risk of an attack while improving human and dog social communication skills, increasing affection and playfulness, and enhancing the dog's willingness to defer and trust family members.

A detailed inventory should be compiled listing all situations in which the dog has either threatened to bite or has actually bitten. The owner is instructed to avoid these circumstances or any other provocative interaction that might lead to aggression. In addition to profiling past aggressive events, the owner should be encouraged to keep a daily journal keeping track of training activities and noting progress or setbacks. Threatening behavior or overt attempts to bite should be recorded with reference to the time, location, and the provoking situation precipitating the aggressive incident (Figure 7.4).

Social Withdrawal, Deprivation, and Cold Shouldering

Preliminary training efforts should focus on adjusting social polarity (see *Reversing Social*

Polarity and Establishing Leadership in Volume 2, Chapter 8), so that the owner becomes the object of increased attention and affection, with the goal of inspiring increased social cooperation and leadership. The owner should encourage the dog to seek attention, affection, and a variety of other rewards by making such things contingent on cooperative behaviors (sit, stand, down, come, stay, wait, and so forth) integrated into everyday activities. Some authorities recommend that a period of social deprivation and cold shouldering should precede NILIF training in order to enhance the dog's interest in social contact and motivation to seek owner affection. The necessity of such a deprivation procedure has not been clearly demonstrated; nonetheless, many anecdotal reports suggest that cold shouldering may pique a dog's interest in social contact and may be useful in some cases not otherwise responsive to reward-based training efforts. If a deprivation procedure is selected, the least amount of deprivation necessary to establish enhanced contact seeking should be used. A significant effect may be produced by as little as a half-day of cold shouldering to prompt a reorientation toward the owner. Typically, the direction of social polarity can be shifted by simply placing access to food, play, or petting on a contingent basis, that is, making the dog beg and work for it. Social deprivation procedures should be considered only in the case of dogs that do not show an active seeking response or willingness to work for the reward. The necessity of more lengthy periods of social deprivation and cold shouldering is questionable and should be avoided, at least until other less intrusive procedures have been tried without success.

Of course, in the case of dogs showing contact aversion with aggressive reactivity, petting and handling may be problematic (see *Contact Aversion and Aggression* in Volume 2, Chapter 8) and should be avoided, at least until progress is made that permits such interaction. In such cases, a brief withdrawal of petting and other forms of gratuitous affection may be beneficial as a starting point. However, the lengthy discontinuation of social contact and comfort giving functions as punishment and may serve only to introduce another element of stress into situation, perhaps making matters worse as a result. Petting and massage provide potential benefits by inducing relaxation and increased feelings of comfort and safety—emotional states incompatible with fear and aggression (see *Taction*

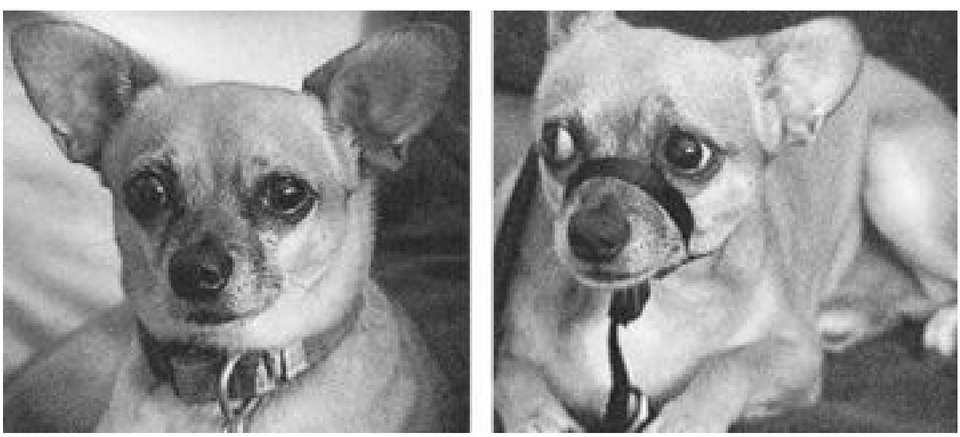

FIG. 7.3. Although most dogs eventually learn to accept halter or muzzle restraint by means of patient exposure and rewards, some may persistently react with an appearance of distress. In the case of this Chihuahua, his demeanor immediately and persistently changed as soon as the halter was fastened and thereafter he lost his appetite for treats, a side effect that severely limited counterconditioning efforts. The dog also refused to eliminate outdoors while walked on the halter, resulting in a brief house-training problem that was immediately resolve by again walking the dog on a leash and collar.

DOG'S NAME: DATE:

RECORD OF AGGRESSIVE BEHAVIOR
(LIST MOST RECENT FIRST)

#	LOCATION	TIME OF DAY	ONGOING ACTIVITY / TRIGGER	TARGET	SEVERITY
1					

DESCRIBE EVENT:	CONSEQUENCES:

#	LOCATION	TIME OF DAY	ONGOING ACTIVITY / TRIGGER	TARGET	SEVERITY
2					

DESCRIBE EVENT:	CONSEQUENCES:

#	LOCATION	TIME OF DAY	ONGOING ACTIVITY / TRIGGER	TARGET	SEVERITY
3					

DESCRIBE EVENT:	CONSEQUENCES:

ADDITIONAL OBSERVATIONS:

FIG. 7.4. Chart for recording aggressive incidents.

and Posture-facilitated Relaxation in Chapter 6). Finally, in addition to lacking scientific justification, the lengthy withdrawal of social contact is highly intrusive and may violate the LIMA principle (see *Compliance* in Volume 2, Chapter 2). Asking a family to arbitrarily withdraw social attention and affection from a dog for long periods (e.g., 2 to 4 weeks) is a recommendation that is not likely to receive a high level of support and compliance. Abruptly withdrawing affection, play, and other forms of friendly interaction from the dog for weeks at a time is a punitive and stressful measure that may only serve to intensify interactive conflict and tensions between the dog and family members. Instead of ask-

ing the owner to withdraw affection and playful interaction from the dog, emphasis is better placed on helping the owner to discover ways to safely integrate affectionate and playful relations between the dog and family members in the process of building a trust-based bond incompatible with aggression (see *Integrated Compliance Training*). While short-term withdrawal of attention and affection may enhance the dog's willingness to beg for social rewards, there is little reason to assume that longer periods of social deprivation will produce a better effect. The benefits of social deprivation appear to be dose dependent, with relatively brief periods of social deprivation (e.g., time-out) enhancing submissive seeking and de-arousal, while longer periods of social deprivation and isolation may produce emotional withdrawal and depression. To my knowledge, no available scientific evidence supports the notion that long-term social withdrawal and tactile deprivation produces any benefit with respect to the reduction of CDA. However, some evidence does suggest that excessive social deprivation and cold shouldering may produce an adverse effect. For example, animals experimentally exposed to tactile deprivation tend to become more aggressively reactive when social contact with conspecifics is restored (see *Posture-facilitated Relaxation Training*).

Attention Therapy and Submissive Following Behavior

A less intrusive method that appears to be useful and more willingly adopted by owners involves an opposite strategy. Many dogs with a history of aggression may be already under the influence of a long period of social withdrawal and reduced affectionate interaction with the family. Social deprivation may naturally follow in the wake of CDA, as family members avoid making risky contact with the dog or withdraw affection from it as the result of a loss of trust, perhaps causing the problem to worsen over time. Instead of further adding to the dog's loss of social contact and other sources of reward, positive social interaction is deliberately intensified by increasing safe, affectionate, and rewarding interaction between the dog and family members. The combination of somatic (comfort and safety) and cortical rewards (surprise) appears to promote an antistress response conducive to an adaptive coping style. Different types of appetitive and social rewards and toys are given to the dog in exchange for little more than orienting, approaching, following, attending, and waiting, that is, engaging in submissive modal activities.

Many dogs exhibiting increased aggressive reactivity may show evidence of attentional and impulse-control deficits. Such dogs may fail to *connect* or integrate an attentive orientation toward social signals, but may instead appear to actively ignore or resist efforts to establish an attentive interface. The dog may not be entirely oblivious to the trainer or unaware of important aspects of significance with respect to the signals given, but rather seem to respond to social signals in a rather narrow and parochial manner with respect to the more subtle cognitive and emotional significance of social communication. Since many aggression problems appear to involve a chronic failure between the dog and family members to competently communicate and adjust in ways that maintain a friendly field of social exchange, it is critical that a process of training aimed at improving cognitive and emotional regulation be initiated. The dog's ability to socially engage and connect with family members may be impeded by a state of anticipatory vigilance and heightened readiness to engage certain family members as threats, possibly stemming from a history of interactive conflict and disorder, mutual incompetence, or stress-related sensitization of FFS pathways. Whatever the original causes of social anxiety and frustration, the symptoms are treated by similar means involving highly predictable and controllable reward-based ICT. The goal of such training is to promote social competence, relaxation, and to reduce interactive conflict systematically. The enhanced comfort and safety produced by such training are incompatible with frustrative readiness and anticipatory anxiety. Further, the increasing competence and confidence associated with instrumental training promote relaxation and an increasing willing-

ness to experiment and take risks toward the production of adaptive prediction error.

With the emergence of active-submission behavior (e.g., food, play, and affection seeking), a series of simple reward contingencies can be introduced to develop prediction-control expectancies and calibrated emotional establishing operations conducive to positive prediction error and surprise. For example, just as the dog orients in response to a squeaker or a smooch sound, the targeting arc is bridged with a click sound followed by a flick of a closed right hand (see *Target-arc Training* in Chapter 3). A vocal bridge is delivered just as the dog approaches the hand, and a reward is delivered by opening the hand. When taking food, the dog is discouraged from jumping up or grabbing at the food too forcefully. As the dog learns to orient to the sound of a squeaker, its name can be presented just in advance of the squeaker sound. The type and size of rewards are varied and presented in a manner that is conducive to positive prediction error and surprise (see *Prediction and Control Expectancies* in Chapter 1). A scented squeaker can also be used as an orienting stimulus or a conditioned diverter. In addition to orienting and bridge conditioning, preliminary training should include training the dog to make and hold friendly eye contact. With the dog standing or sitting, the trainer calls the dog's name or makes a smooch sound, followed by a bridge ("Good" or click) and the delivery of a food reward (see *Introductory Lessons* in Chapter 1). Training the dog to orient and hold sustained eye contact enhances the dog's ability to discriminate the trainer's actions and intent accurately and competently, thereby improving social communication and reducing the risk of aggression due to reactive adjustments. Squeakers can be placed on treat boxes and kept with leashes, toys, and other sources of attractive stimulation. The owner is instructed to sound the squeaker when coming into the house, especially at homecomings after a lengthy absence. The stimulus change is aimed at intensifying affectionate and appetitive attraction, precisely the opposite of the cold-shoulder procedure as described previously. The goal of these preliminary attention and orienting procedures is to make the owner a source of focused attention and following behavior.

When taking food, the dog is discouraged from jumping up and encouraged to take the treat gently. Initial lessons should focus on training the dog to come from various place in the home. The squeaker can be used to get the dog's attention, followed by the word "Come" as the dog turns toward the trainer. The dog is rewarded upon coming and immediately released with "OK" and a clap. Once the dog learns to orient to the sound of squeaker, its name can be presented just in advance of the squeaker sound. After the dog has learned to come reliably, it is encouraged to follow along at the trainer's left side and is immediately rewarded as it approaches. Every few steps, the trainer rewards the dog so long as the dog remains close by on the left side. If the dog becomes distracted and moves away, the squeaker is squeezed and the orienting response is bridged with the clicker, as the trainer turns away from the dog and encourages the dog to follow along with friendly smacking, smooching, and sweet talking, whereupon it is rewarded by saying "Good," and the food reward is delivered from a closed hand. With the presentation of most food rewards, the dog is petted under the chin and other locations producing an affectionate response. Once the dog is coming and following the trainer, a sit response is introduced. With the dog following at the left side, the trainer clicks, stops, and waives the right hand over the dog's head. As the dog sits, the trainer says "Good" and rewards the sit action as it is completed. After staying for a brief period, the dog is rewarded again and periodically thereafter on a variable-duration schedule, but must continue sitting until it is released with an "OK" and clap signal. During the sit-stay, the dog should be encouraged to make and maintain eye contact with the trainer, especially at the beginning and at the end of the exercise. As the dog's abilities improve, variations are introduced and practiced with the purpose of increasing attention and impulse-control abilities. Voith's (1977) sit-stay program provides a systematic way of developing sit-stay and impulse-control abili-

ties conducive to attention-therapy objectives (see Appendix A).

Integrated Compliance Training

The vast majority of domestic dog bites signify the presence of reactive incompetence in association with an ISS and a failure of the dog to integrate harmonious and trusting relations with family members. Restoring a trust-based bond incompatible with aggression depends on competence-enhancing ICT and the formation of affectionate and playful dynamic modal relations. An important function of ICT is to establish orderly cooperative relations between the dog and family members in association with everyday activities and sources of potential interactive conflict.

A significant aspect of social competency includes training the dog how to obtain and perpetuate gratifying experiences without resorting to aggression. In addition to relinquishing control over resting areas and possessions, the dog should learn when access to such things is permitted and how to go about getting such access. Similarly, the dog should learn to wait and make eye contact before entering or leaving the house. Social nuisances (e.g., barking and jumping up) can be brought under the control of vocal and gestural signals and then appropriately prompted and rewarded or discouraged as required by the particular situation. For example, during homecomings, the dog can learn to wait before being invited to jump up to say hello. Pawing dogs can be trained to give a paw on signal while pawing at other times is discouraged by the loss of reward. Rather than forbidding behavior, generally the best strategy is define occasions when such behavior is acceptable and productive of reward. Rather than reflecting dominance-related incentives, CDA most often involves a persistent failure of dogs to regulate aggressive impulses competently in the presence of social actions portending a loss of comfort or safety. Most dogs exhibiting domestic-aggression problems do not appear to be competing for rank or privileges of status, but are simply exhibiting socially inept and reactive behavior under the influence of autoprotective incentives. Aggression in such cases appears to stem from a history of inappropriate or inadequate owner control efforts and a failure to integrate friendly and playful dynamic modal relations and roles into a VSS for obtaining reward and avoiding punishment. According to the involuntary subordination hypothesis, reactive domestic aggression is prone to develop in the context of persistent interactive conflict and tensions, whereby interaction with the owner sensitizes the dog to social signals of punishment (loss of reward and nonreward).

Interactive conflict and tensions (intolerance and irritability) emerge in the context of antagonistic control incentives converging on points of common interest. Instead of the owner taking ownership of the resource and providing the dog access to it in accordance with a rule-based contingency promoting compromise and cooperation (VSS), the owner may interfere or compete with the dog by punishing reward-seeking activity or by preventing the dog from obtaining gratification (comfort and safety); that is, the owner comes between the dog and reward or physically denies the dog access to it, but without leading the dog to obtain the reward in a cooperative way. In such cases, ICT can be extremely useful for establishing a rule-based pattern of social interaction promoting enhanced cooperation and trust (see *Benefits of Cynopraxic Training* in Chapter 1). Sources of agitating interactive conflict are identified and objectified as potential sources of reward for mediating mutual appreciation and interactive harmony. Conflict is resolved by enhancing the owner's ability to take ownership of rewarding resources and to exert competent control by means of limit-setting actions and reward-based training, whereby subordinate compromise and cooperation are rewarded by access to previously barred activities and objects of reward. By such means, a VSS is mediated with the dog becoming progressively sensitive and alert for signals of social and appetitive reward while at the same time helping to mobilize oxytocinergic antistress and calming effects associated with the flirt-and-forbear coping style (see *Oxytocin-opioidergic Hypothesis* in Chapter 6). Instead of punishing aggressive tendencies, training is

dedicated to instilling a heightened sense of trust and confidence in the owner as leader and friend. Emergent mutual competency and confidence between the dog and the owner naturally result in increased behavioral flexibility and relaxation. Rule-based social interaction facilitates cooperative behavior and prediction-control expectancies incompatible with reactive irritability and intolerance, educating the dog to form an affectionate, cooperative, and trusting orientation with respect to family members.

The effectiveness of ICT is enhanced when performed in conjunction with other training and therapy procedures. In addition to learning how to acquire rewards under an owner's control, a dog needs to learn how to cope with everyday provocative challenges via graduated exposure to directive control. Such training helps to restore a dog's sense of safety and control. By means of complementary behavior-therapy procedures, including graduated directive control and punishment (TO), nonprovocative restraint and taction therapy (PFR training), and avoidance training when appropriate, a dog in stages learns that it can control rewarding situations as well as provocative or mildly threatening ones without losing trust and resorting to aggression. In addition, behavior that is successfully brought under the control of appetitive and social rewards and avoidance training is steadily integrated and brought under the influence of ludic incentives by means of play training. Play antagonizes the emotional irritability and rigidity commonly present in dogs exhibiting CDA. Play is particularly valuable for integrating dynamic modal relations and promoting interactive harmony, tolerance, and trust. The success of an aggression-therapy program is based on the shaping of overt behavior incompatible with aggression, giving evidence of at least three areas of improvement: increased composure (competence and confidence), relaxation, and playfulness. Since aggressive threats may be rapidly suppressed by means of punishment, but without necessarily reducing the risk of overt aggression, the mere absence of aggression is not a useful measure of improvement. Evaluations based solely on the absence of aggression violate the dead-dog rule (see *Dead-dog Rule* in Volume 2, Chapter 2). Ultimately, the goal of dog behavior therapy, as well as preventive training, is to reduce the risk of CDA by taking appropriate safety precautions and promoting a more playful and trusting bond between the dog and family members.

Counterconditioning

Previously conditioned aversive and appetitive stimuli are subject to a variety of modifying influences, including extinction and counterconditioning. For example, if an conditioned stimulus (CS) is repeatedly presented independently of an unconditioned stimulus (US), the conditioned association between the CS and US will gradually degrade or extinguish, but it will not be permanently uncoupled. Contrary to a popular belief, extinction does not erase past learning. As a behavior-therapy procedure, extinction is notoriously inefficient and subject to "savings" that make its use problematic in the treatment of behavior problems (see *Spontaneous Recovery and Other Sources of Relapse* in Volume 1, Chapter 6). Counterconditioning provides a more effective and reliable means for altering conditioned aversive associations than punishment and extinction. Rather than passively discontinuing the contingency between the CS and US, counterconditioning actively establishes a new contingency and expectancy between the eliciting stimulus and the emotional arousal elicited by it. This change is produced by arranging the fear- or anger-eliciting stimulus to occur in close association with the elicitation of a stronger and incompatible response that overshadows and antagonizes aversive arousal.

Counterconditioning has many applications in dog training and behavior therapy, but is especially useful in cases involving problem behavior operating under the influence of specific conditioned aversive stimuli and evoking contexts (see *Counterconditioning* in Chapter 3). The process is based on the antagonizing effects that responses of opposite emotional and hedonic significance have on one another:

1. If two emotional responses of opposite motivational and hedonic significance are elicited at the same time, the stronger response will tend to overshadow and antagonize the weaker one.
2. If both emotional responses are of approximately equal strength, they will antagonize each other and produce varying degrees of emotional conflict.
3. If an aversive response is stronger than the antagonizing response, the latter will fail to restrain the former and may instead become associatively linked to it.

The risk of producing emotional conflict and stress or conditioning the antagonizing stimulus to elicit rather than restrain the aversive response underscores the importance of gradual exposure when applying a counterconditioning procedure and performing counterconditioning in conjunction with appropriate precautions and response-prevention procedures (see *Fear Reduction and Approach-Avoidance Induction* in Chapter 3). Counterconditioning usually involves the presentation of a series of graduated exposures in which provocative stimuli or situations are repeatedly presented to the dog in a progression of increasing strength and potential for eliciting aversive arousal while the dog is simultaneously presented with a stronger antagonizing stimulus that overshadows or restrains aversive arousal. After repeated trials in which the antagonizing stimulus successfully restrains aversive arousal, the provoking stimulus gradually becomes linked with the antagonizing stimulus and the emotional arousal produced by it. If the antagonizing and provoking responses are of approximately the same magnitude, stressful conflict may ensue adversely affecting counterconditioning efforts.

The provoking stimulus, as the result of newly formed associations with emotional arousal elicited by the antagonizing counterconditioning stimulus, gradually acquires new predictive and emotional associations that are incompatible with its previous significance. The power of counterconditioning to alter the significance of conditioned aversive stimuli makes it highly useful for the treatment of many aggression problems. For example, presenting food (antagonizing stimulus) to a hungry dog that resents reaching and petting actions (provoking stimuli) may gradually alter the dog's response to such activity by the overshadowing effect of appetitive arousal. First tossing food to the dog from a distance, and then through progressive steps giving it to the dog by hand, may help to alter the dog's response to reaching and petting actions via the antagonizing effect of appetitive arousal. Over several trials, the dog may learn to welcome the previously provocative actions, now interpreting them as antecedents associated with getting food. A similar counterconditioning procedure can be used to alter aversive associations linked with being leaned over or stared at and so forth, thereby changing the dog's expectations regarding the significance of such actions. By repeatedly pairing provocative gestures and postures with the presentation of food (tossed to the dog), the dog is provided with new information with which to reinterpret and modify its expectations of such interaction.

The antagonizing effects of counterconditioning on aversive emotional arousal appear to benefit from the additive effects of multiple sources of antagonistic stimulation. Any conditioned or unconditioned stimulus can be used for counterconditioning purposes so long as it is capable of evoking a reliable incompatible emotional response from the dog. The selected stimulus can be used alone or in combination with other similarly effective stimuli. Food is the most commonly used antagonizing stimulus in routine training efforts, but affectionate petting and talking, massage, and play are also often used in combination or separately to antagonize aversive emotional arousal. The potency of food as a counterconditioning stimulus is dependent on the dog's level of hunger and its appetite for the food given to it. Increased appetitive counterconditioning effects can be produced either by increasing the dog's level of hunger or by increasing the appetitive value of the food reward. Although a 12- to 24-hour deprivation period is usually sufficient to pique an increased interest in food, some dogs with

reduced appetites (not uncommon among stressed fearful or aggressive dogs) may require a reduced-calorie diet or medication in order to generate a more conducive level of motivation for appetitive counterconditioning. A significant enhancement of food as a antagonizing stimulus is achieved by varying the type and amount of food given to the dog from trial to trial. Odors that have been previously paired with relaxation induced by massage and PFR training work well in combination with other counterconditioning stimuli. The conditioned odor is delivered on the breath, hands, or body or by other various other unobtrusive means (e.g., squeaker bulb). Conditioned odors appear to help the dog relax, possibly restraining undesirable aversive arousal and thereby rendering the dog more receptive to other counterconditioning effects. The ultimate usefulness of ICT, counterconditioning, and other reward-based training efforts will hinge on the dog's willingness to integrate friendly relations with the target of aggression. Some dogs, despite the most conscientious and dedicated efforts, may continue to show a threatening attitude, remaining intolerant and reactive to the approach of certain family members. The subgroup of domestic aggressors that fail to show signs of integrating friendly and submissive relations in response to reward-based training and counterconditioning efforts, should be removed from the home. During all counterconditioning procedures, the dog should be appropriately restrained on leash, control post, halter, or muzzle, as necessary for safe exposure, handling, and response prevention.

Although counterconditioning appears to have several useful applications in dog training, there have been a number of laboratory studies that have questioned the efficacy of the procedure for modifying fears (see *Critical Evaluations of Counterconditioning* in Chapter 3) and aggression (see *Counterconditioning: Limitations and Precautions* in Chapter 8). Currently, the value of counterconditioning for controlling aggression remains unproven, however, sufficient anecdotal evidence and case reports exist to support the use of counterconditioning as a support tool in the context of canine behavior therapy, but perhaps not as a stand alone classical conditioning procedure. Cynopraxic training theory emphasizes the unity of prediction-control expectancies, emotional establishing operations, and goal-directed action in the process of organizing adaptive behavior, making stand alone counterconditioning unnecessary. In general, the gradual disconfirmation of aggression-provoking expectancies by means of repeated instrumental exchanges around reactive points of conflict that result in mutual reward serves to integrate more competent and cooperative social behavior while naturally altering emotional establishing operations and control incentives in ways that are incompatible with aggression. Whatever benefits might be achieved by countercondtioning in isolation are achieved by cynopraxic training and therapy efforts in the process of shaping more competent prosocial and friendly behavior.

The effects of counterconditioning appear to be particularly problematic and variable in the treatment of impulsive, reactive, and trait aggression (see *Conflicts and Rituals Toward Novel Social Stimuli* in Chapter 8). For example, dogs possessing strong watchdog propensities may be genetically contraprepared to respond to counterconditioning efforts. In the absence of social familiarity and attraction, dogs expressing a rigid watchdog script may be unable to experience outsiders with the sort of trust needed to render food-sharing exchanges as safe–a precondition required to mediate the social benefits of counterconditioning. In addition, dogs expressing unstable temperaments and reactive coping styles may function under a persistent negativity bias for signals of punishment (loss and risk)—a bias that may overshadow and block counterconditioning effects. Counterconditioning may also prove problematical in the case of avoidance-related aggression problems (see *Response Prevention*) or aggression occurring in association with an ISS that has been partially suppressed by physical punishment. In the latter case, as fear is reduced by counterconditioning a transitional point may be reached that significantly increases the risk of aggression (see *Graded Exposure and Response Prevention* in Chapter 3).

Time-out

Although punishment can significantly complicate matters, if used properly and selectively, it can also provide a useful means for controlling certain forms of CDA. The primary function of punishment is to offset or minimize reinforcing consequences produced as the result of aggressive actions. Punitive measures incorporating disruptive startle or momentary social isolation are superior to procedures that depend on manual restraint and physical punishment. Ideally, punitive measures should meet at least two criteria: (1) punishment should not evoke more aggression, and (2) punishment should be motivationally relevant and antagonistic to the goals of aggression. A powerful punitive technique that meets both of these criteria is time-out (TO), which has been shown to suppress avoidance-motivated behavior (Nigro, 1966), competitive excesses in puppies (Polsky, 1989) and aggressive behavior in dogs (Nobbe et al., 1980) (see *Using Time-out to Modify Behavior* in Volume 1, Chapter 8). In addition to promoting rapid de-arousal, the brief period of isolation associated with TO serves to heighten subsequent interest in social contact and other rewards made available during time-in (Figure 7.5).

Besides being effective with minimal risk of side effects, TO avoids the hazards associated with physical punishment. Appropriate restraint and control of the dog is crucial for the effective use of TO. As deemed necessary to ensure safety, an aggressive dog should be kept on leash with a slip collar, halter, or muzzle at all times when it is in contact with people. If the dog lunges or snaps during exposure and counterconditioning efforts, the leash is pulled tight and the dog is rapidly hauled off to a separate room under continuous leash pressure (bridging stimulus). The entire procedure should make the dog experience a dramatic loss of control over the situation as the result of the aggressive action. When pulled forward by the leash, most dogs resist by pulling back, making forward attacks less likely, but such attacks do occur and may necessitate emergency defensive measures to counter. Dogs presenting such a risk should be kept on a muzzle-clamping halter or muzzle and slip collar. Rather than forcing the dog into the TO room or swinging it around, the trainer should enter the TO room (e.g., bedroom) and back out, leaving the dog on the other side. In cases where there is not enough room to turn around easily, the dog can be left outside of the room as the trainer enters and closes the door on the leash. A moment should be taken to make sure that the dog is clear of the door as it is slowly closed and then, when approximately 1 inch from being fully closed, the door is sharply shut for emphasis. The leash should be pinched in the doorjamb approximately 8 inches above the door handle, leaving only enough slack on the other side for the dog to stand or sit but not leaving room for it to move around or lay down. If the dog complains or scratches, the door can be opened a crack and an upward leash prompt can be delivered to discourage the behavior. After 30 to 60 seconds, the trainer should praise the dog as it is released from TO. The dog is immediately returned to the eliciting situation where an incompatible response is prompted and rewarded, thereby setting the stage for more positive and cooperative interaction. In the case of dogs that have received PFR training and olfactory conditioning, the odor used can be diffused into room to help facilitate relaxation and reduce aggressive tensions.

TO can be effectively used to control a variety of attention-seeking and competitive excesses that may also present with an aggression problem (see *Time-out, Response Prevention, and Overcorrection* in Chapter 5). After each TO, the dog is taken back to situation where the misbehavior occurred, and more appropriate behavior is prompted and rewarded. The TO procedure is repeated as needed until the undesirable response is suppressed or weakened sufficiently to allow for effective conditioning of alternative behavior. The suppressive effect of TO is cumulative and most common social excesses respond within three or four repetitions in close succession, given that an alternative behavior is encouraged at the same time. To be maximally effective, TO should be carried out in the context of a reward-dense training environment (see *Time-in Positive Reinforcement* in Volume 1, Chapter 8).

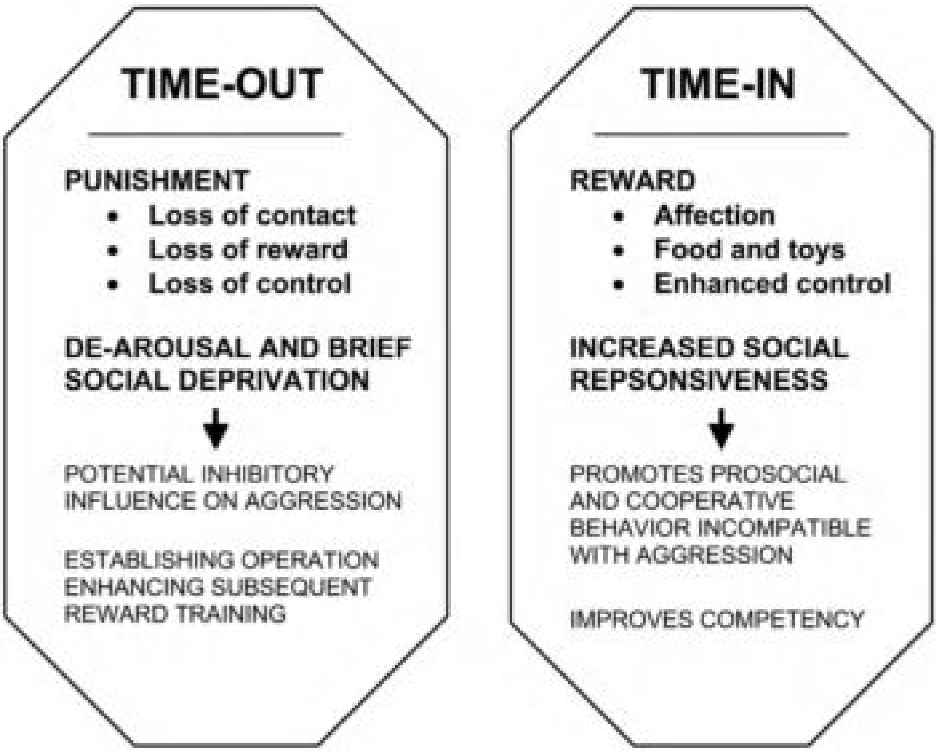

FIG. 7.5. Time-out (TO) is a highly effective punishment technique for the control of some forms of aggressive behavior. TO should be brief and performed within the context of reward-dense time-in (TI) training and counterconditioning efforts. The absence of a reward-dense TI situation significantly reduces the effectiveness and value of TO.

Response Prevention

Since many aggressive dogs appear to threaten or bite as the result of avoidance learning in association with the activation of the FFS, special problems may be encountered that necessitate the use of response-prevention techniques (see *Response Prevention and Directive Training* in Volume 1, Chapter 6, and *Graded Exposure and Response Prevention* in Chapter 3). Aggression operating under the influence of avoidance learning may persist despite conscientious counterconditioning and other positive training efforts. According to the Seligman-Johnston theory (Seligman and Johnston, 1973), once an avoidance response is established, the role of fear is gradually subordinated to reinforcement or extinction effects mediated by the confirmation or disconfirmation of expected outcomes occurring in association with the avoidance response (see *Fear, Cognition, and Avoidance Learning* in Volume 2, Chapter 3). If the avoidance response preempts the aversive event, the controlling avoidance expectancy is confirmed and the response is reinforced, whereas, on the other hand, if the aversive event follows despite the occurrence of the avoidance response, the controlling avoidance expectancy is disconfirmed and the avoidance response is punished and undergoes extinction. The crucial issue here is that fear and its reduction are not directly relevant to the maintenance of a well-established avoidance response. Further, since reinforcement of the avoidance response is based on the preemptive nonoccurrence of the aversive event, the avoidance response may continue long after the aversive threat is removed. Consequently, despite intensive counterconditioning, an

avoidance response may continue intact so long as the controlling expectancy is not disconfirmed or until an incompatible expectancy and response are formed.

There are two ways to disconfirm a faulty avoidance expectancy: (1) arrange for the avoidance response to fail (extinction-punishment), or (2) prevent the avoidance response from occurring in the presence of avoidance discriminative stimuli (response prevention). In the first instance, the aversive event is arranged to occur contingently upon the emission of the avoidance response (punishment), thereby disconfirming the controlling avoidance expectancy. As a result, the dog may experiment with other escape strategies until a response is found that succeeds. Consequently, the successful escape response will take the place of the disconfirmed avoidance response and continue so long as it successfully produces outcomes that confirm the modified avoidance expectancy. Although representing the most common procedure used to control avoidance aggression, the approach is problematic and fraught with risk. Under the influence of physical punishment, avoidance-related aggression may rapidly escalate and become significantly worse as the result of vicious-circle effects. In the second case, the avoidance response is prevented from occurring in the presence of avoidance-signaling discriminative stimuli, thereby compelling the dog to recognize that the avoidance response is no longer necessary. As a result of response prevention, the dog learns that the avoidance signals no longer predict an aversive event and that the avoidance contingency has been discontinued, thereby resulting in the extinction of the avoidance response. During exposure with response prevention, a new significance can be effectively linked with the defunct avoidance signals by means of counterconditioning. If a defunct avoidance signal is repeatedly paired with an attractive event (e.g., food, petting, or play), a new incompatible association and function are produced, whereby the previous avoidance expectancy is not only disconfirmed, but is gradually replaced by an antagonistic approach expectancy.

Similarly, in the case of avoidance-related aggression, a dog may continue to threaten or bite under the influence of a faulty avoidance expectancy, with the character of aggression becoming progressively confident and fearless as the result of a history of successful control, especially if it occurs in the absence of reprisals. The controlling avoidance expectancy may continue to maintain the aggressive response despite intensive counterconditioning and absence of aversive stimulation. The avoidance-related aggressive response is reinforced preemptively, requiring only that the original aversive event not follow the occurrence of an attack—an outcome that would disconfirm the controlling avoidance expectancy. As a result, avoidance-related aggression may continue to occur in the presence of certain social signals that are often benign and innocuous, until the aggressor discovers that the controlling avoidance expectancy is faulty and the aggressive avoidance response is unnecessary and defunct. Under normal circumstances, the avoidance aggressor may not discover that the avoidance contingency is no longer in effect, causing it to threaten or bite in the absence of actual threats and discomfort. By means of response-prevention procedures in which aggression is prevented by various means, including leash and halter restraint, crate confinement, and muzzling, the dog is compelled to learn that the avoidance threat or attack is unnecessary. Exposing a dog to innocuous and mildly provocative social stimuli, while at the same time blocking aggressive responses, gradually causes the dog to recognize that the aggressive response is unnecessary to protect its safety. Response-prevention procedures should be performed in a way that emphasizes safety from aversive stimulation. The presence of attractive and relaxing stimuli and a familiar location may help to reduce adverse emotional arousal associated with restraint and exposure. In addition, a graduated counterconditioning procedure is often used during response prevention in order to link provocative social signals with antagonistic emotional arousal incompatible with aggression, thereby replacing the defunct aggression-avoidance expectancy with an incompatible affiliative-

approach expectancy. In some cases, especially those that are unresponsive to response prevention and graduated counterconditioning, punishment (TO) can be a viable means to disconfirm the controlling avoidance expectancy. Punishment in such cases works to the extent that it causes the aggressive avoidance response to fail while at the same evoking a response incompatible with aggression that permits reinforcement by the owner as a source of safety and comfort. However, inappropriate physical punishment may only cause the dog to fight back more violently under the combined excitatory influences of fear and anger, thereby resulting in a stronger and more dangerous response—a significant risk associated with punishment. Panic-related aggression may, in some cases, result from physical punishment inappropriately applied against avoidance-related aggression, thereby producing a much more dangerous and difficult-to-control problem.

Posture-facilitated Relaxation Training

Evidence of contact aversion and resentment of handling is frequently exhibited by aggressive dogs. Dogs may become averse to such interaction as the result of a history of unwelcome handling in the past (e.g., excessive picking up and hugging) or aversive-traumatic conditioning (e.g., physical punishment or traumatic restraint) (see *Contact Aversion and Aggression* in Volume 2, Chapter 8). Extremes involving too much (agitation) or too little (deprivation) tactile stimulation and handling may result in contact and handling aversion. Petting may be particularly annoying for dogs that lack a trusting bond with their owners. Whatever the cause, it is clear that tactile stimulation exerts a profound influence on a dog's emotional state, with the dog's relative receptivity to petting and other forms of handling reflecting various biogenetic and acquired differences affecting emotional reactivity, social attraction, and propensity for aggression (see *Taction and Posture-facilitated Relaxation* in Chapter 6).

Prescott (1971) has emphasized the role of tactile deprivation as a causative factor predisposing animals to overreact to social tactile stimulation. He has postulated the existence of a somatosensory-cerebellar pathway mediating increased excitability and stimulus-seeking behavior resulting from tactile deprivation. According to Prescott's hypothesis, stress associated with tactile deprivation promotes the development of a variety of emotional and behavioral disorders, including depressive reactions, stereotypies, hyperactivity, hyperexcitability, excessive seeking behavior, habituation disturbances, impaired pain sensitivity, and impulsive aggressive behavior (Prescott, 1971). Cairns (1972) also found that mice tend to become more reactive, irritable, and aggressive as the result of tactile deprivation. He tested this hypothesis by comparing the reactivity of social isolates to different sources of sensory stimulation, finding that isolates were much more emotionally reactive to tactile stimuli than to visual or auditory stimuli. Fuller (1967) found that isolated puppies were less fearful and reactive in an unfamiliar area if they were handled and stroked before and after exposure. Handling appeared to reduce arousal levels and stress-related reactions evoked by the situation. Persons with autism often show an aversion to tactile stimulation, causing them to stiffen, flinch, or attempt to pull away when touched. Autism is an emotionally insular condition of isolation and inability to relate empathetically with others. The autistic aversion to touch contact appears to be ameliorated by massage, an effect that may be facilitated by the highly predictable and rhythmic nature of the process (Field, 1995). Similarly, dogs exhibiting contact aversion toward human touch and handling often show a positive response to massage in the context of PFR training.

A central focus of PFR training is to form positive conditioned associations with handling and restraint via graduated exposure and massage, response prevention, counterconditioning, and the induction of progressive relaxation, with the net effect of antagonizing reactive emotional responses to such contact (see Appendix C). In addition to inducing relaxation, massage with PFR training, when performed in a highly repetitive and stereotypic manner, appears to produce significant benefits in most dogs by reducing stress, by

promoting deference to manual control, and by reliably producing comfort and feelings of safety—behavioral and emotional effects that are highly beneficial in the context of behavior therapy. Nonthreatening manual restraint and postural shifts ranked in terms of a progressive loss of control and submission play an instrumental role in this process of progressive subordination and relaxation (see *Posture, Response Prevention, and Posture-facilitated Relaxation* in Chapter 6). PFR training facilitates a more organized psychophysiological response (parasympathetic dominance) by competing with the reactive and disorganizing influences of sympathetic arousal occurring in association with fear, anger, and frustration.

Dogs with a history of overt aggression should be handled with caution and always kept under appropriate restraint during PFR training. Dogs posing a significant risk of aggression should be leashed and muzzled during PFR training (Figure 7.6). In addition to reducing the risk of attack, the muzzle can provide a salutary response-prevention effect if properly introduced and used. As the risk of aggression is reduced, the level of restraint can be proportionately adjusted to match the risk presented by the dog. The provision of ambient music during PFR training may help to facilitate a relaxation response in some reactive dogs. Wells and colleagues (2002) have reported that classical music appears to exert a calming effect in dogs, as indicated by decreased barking and a greater amount of time spent resting in comparison to controls (no stimulation) living in a kennel environment. Each postural prompt and shift of position is paired with the word "Relax" or "Easy," vocal signals that may be gradually conditioned to predict safe handling and comfort. As the PFR cycle progresses, an olfactory stimulus can be introduced and paired with the deepening relaxation response (see *Olfactory Conditioning* in Chapter 6). After several cycles of PFR training, the odor can be presented at earlier points in the massage sequence, thereby acquiring conditioned properties associated with the induction of relaxation. Gradually, the odor itself can be use to produce a facilitatory effect on the induction and depth of the relaxation response. Certain odors may exert an intrinsic calming effect that may make them more associable with massage-induced relaxation (see *Fear of Loud Noises and Household Sounds* in Chapter 3). For example, chamomile and lavender have been shown to reduce alpha 1 activity in association with subjective reports of increased feelings of comfort (Masago et al., 2000) and stress reduction (Motomura et al., 2001). The conditioned odor can be delivered by a squeaker or by hand or more generally by a mister or a pump diffuser. The conditioned odor is used in conjunction with other behavior-therapy procedures to help manage aversive states and promote relaxation during counterconditioning efforts.

Punishment

Punishment in the case of CDA should be viewed as a damage-limiting option rather than a routine aspect of the behavior-therapy process. Although harsh physical punishment is inappropriate and should be avoided, overt control-related aggression should be countered with disruptive startle or TO whenever possible, but only in situations were the punitive event can be safely performed and is unlikely to cause the dog to escalate aggressive efforts. Such punishment is primarily performed to offset inadvertent reinforcement that may be produced by overt aggression. Despite the risks involved (see *Species-typical Defensive and Offensive Aggression*), a limited use of punishment may be expedient in some cases, but only after basic control is established by means of reward-based training (Line and Voith, 1986). However, instead of focusing too much attention on punishment, the emphasis should be placed on avoiding provocative social interaction that poses a risk of triggering aggressive episodes while at the same time increasing the probability of evoking more friendly behavior. Finally, once reward-based control is established, mild punishment and avoidance training may be useful to further enhance competent coping skills. As the result of effective reward-based training and gradual exposure to inhibitory training, dogs learn how to regulate their responses to mildly provocative stimulation more adaptively and competently—influences that are highly beneficial

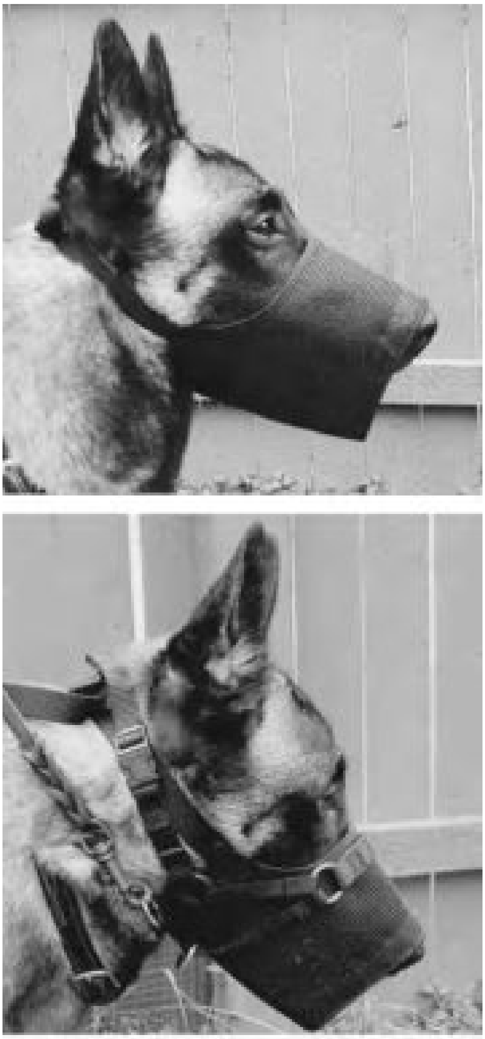

FIG. 7.6. A variety of muzzles are available, but perhaps the most comfortable are those made with a mesh fabric. The muzzle should be introduced gradually in association with highly attractive treats and other positive outcomes. Introducing muzzles too rapidly or roughly may cause dogs to react aggressively or refuse to let themselves be muzzled in the future. Muzzle and halter training requires significant experience and skill to avoid situations that might result in bites to the hands. In situations requiring a high degree of control while limiting the risk of biting, a halter and muzzle can be used in combination.

in the treatment of most forms of domestic aggression.

MANHANDLING AND PHYSICAL PUNISHMENT

Until relatively recent times, harsh physical punishment (e.g., beating) was commonly recommended as a preferred means for controlling aggression and other behavioral excesses (Most, 1910/1955; Lorenz, 1955). Although the measured use of physical force by leash and momentary manual imposition can be useful for enhancing control from time to time, manual methods that intentionally and routinely involve hitting, wrestling, and provocative manhandling directed against aggressive dogs have little (if any) redeeming value for long-term and generalized control of aggression and may make such problems potentially far worse than if nothing had been done at all. Even in cases where such methods succeed in intimidating the aggressor, there is little chance that the inhibition will generalize to other family members who are unable to defend themselves with such physically demanding and skill-dependent punitive actions. In situations where such punishment is used, children may be exposed to an increased risk of attack as the result of punitive agitation, unanticipated behavioral contrast effects (see *Behavioral Contrast and Momentum* in Volume 1, Chapter 7), and redirected attacks. Finally, severe physical punishment may succeed in suppressing threat displays, but without significantly modifying the dog's emotional propensity for aggressive behavior (see *Assessment and Treatment Priorities*). As a result, the roughed-up dog may gradually learn to bite without warning or bite preemptively when threatened by the owner with such treatment. In summary, there are three major problems associated with forceful manhandling and punishment:

- Manhandling places inexperienced dog owners at a significant and unnecessary risk of being bitten.
- Manhandling does little to change the causes of domestic aggression substantially and may actually cause the dog to escalate its aggressive efforts against the owner.
- Manhandling may rapidly suppress threat displays without reducing a dog's propen-

sity to bite, perhaps increasing the dog's aggressive propensity while at the same time making it less predictable and more dangerous.

The use of provocative striking, manhandling, and restraint techniques should be avoided except in the rare case of self-defense and the protection of others, where alternative means of emergency restraint are not available or prove inadequate. Trainers are under a professional obligation to perform training services with dogs under appropriate restraint and to avoid provocative circumstances that necessitate such methods of intimidation for self-defense. Mistakes can happen, and trainers should be skilled in a variety of restraint techniques for responding to such emergencies, but they should never be mistaken for training procedures.

Ramona Albert (1953) once sardonically observed that roughing up an aggressive dog made about as much sense as the old rhyme: "A woman, a dog, a walnut tree; the harder you beat them the better they be." Nothing could be more futile and wrongheaded than beating an aggressive dog, but with regard to beating a walnut tree, at least such activity might be edifying for those unable to see with open eyes and heart that nothing good has ever come of hitting dogs or women. Corporal punishment is a destructive act that risks losing a dog's trust and permanently damaging the human-dog bond. Cynopraxic trainers and applied dog behaviorists would do well to exemplify in word and action the embodiment of patience and forbearance, thereby avoiding the psychological and spiritual trap of manhandling and corporal punishment as a necessity of control, which it most assuredly is not. Given the current level of practice, there is no legitimate excuse for roughing up a dog to train it. The last of a series of principles enunciated by Skinner for his utopian society Walden Two included the following item apropos to the current discussion: "Regard no practice as immutable. Change and be ready to change again. Accept no eternal verity. Experiment" (Skinner, 1979:346). Once free of the option to hit and manhandle, the training process gradually becomes more thoughtful, creative, experimental, playful, friendly and, most importantly, more successful and rewarding in terms of forming a trusting bond—an essential requirement for the control of domestic-aggression problems.

Aggression and Diet

Reduced Dietary Protein, Serotonin Production, and Aggression

Although the current evidence is equivocal with respect to the benefits of a diet containing reduced dietary protein for managing CDA, preliminary veterinary data suggest that some dogs exhibiting territorial aggression with fear may benefit from a low protein diet (Dodman et al., 1996b), especially when it is supplemented with tryptophan (De Napoli et al., 2000). De Napoli and colleagues have reported that dogs diagnosed with dominance aggression may also benefit from a low-protein diet or a high-protein diet enriched with tryptophan (see *Nutrition and Aggression* in Volume 2, Chapter 6). Salazar (2000) has proposed the hypothesis that increased insulin sensitivity to alpha-lipoic acid may influence circulating levels of tryptophan and thereby facilitate transport through the blood-brain barrier and increase its availability for serotonin synthesis (see *Diet and the Enhancement of Serotonin Production* in Volume 1, Chapter 3). Future studies using low-protein diets to modify serotonin production in dogs may want to consider the potential additive benefits of alpha-lipoic acid and dietary carbohydrates for improving tryptophan transport through the blood-brain barrier.

For various metabolic, physiological, and practical reasons, 5-hydroxytryptophan (5-HTP) may be more useful as a means for enhancing serotonin production than tryptophan. 5-HTP is the immediate precursor of serotonin and more easily crosses the blood-brain barrier than does tryptophan. Whereas the synthesis of 5-HT from tryptophan is dependent on an intermediate rate-limiting step and the availability of the enzyme tryptophan hydroxylase, 5-HTP is synthesized directly into 5-HT. Another important advantage of 5-HTP is availability. Unlike tryptophan, a product that is not currently available in a purified form over the counter, 5-HTP

can be readily purchased. 5-HTP should be handled with respect, since accidental ingestion of it by dogs can result in severe toxicosis or death. Gwaltney-Brant and colleagues (2000), who investigated several reports of 5-HTP toxicosis in dogs, found that the minimum dose producing a toxic effect in dogs was 23.6 mg/kg, with a minimum lethal dose placed at 128 mg/kg. To put these findings into perspective, a 70-pound dog would need to ingest 749 mg (15 capsules containing 50 mg each) to become sick or 4.07 g (81 capsules containing 50 mg each) to reach a lethal dose. Of course, these doses are significantly higher than the amounts used therapeutically, but the report underscores the importance of keeping all medications out of a dog's reach and giving them only under the supervision of a veterinarian.

If a low-protein diet is used, in addition to reducing protein content to 15% to 18%, dietary levels of carbohydrate and fat should be adjusted and balanced to match a dog's energy needs. Supplementing the diet with vitamin C and E, alpha-lipoic acid, and a balanced spectrum of polyunsaturated fatty acids (especially omega-3) may provide additional benefit with respect to normalizing serotonin activity and reversing neuronal damage resulting from oxidative stress. Some special and senior diets are currently available with the appropriate levels of protein, but they may need to be supplemented with additional fat and carbohydrate. Cooked salmon (1 part), turkey (1 part), spinach (2 parts), and rice (6 parts) can be prepared on a weekly basis and shaped into the form of meal-sized balls and frozen. At feeding times, the rice balls are thawed by microwave and mashed into the low-protein senior diet. High-carbohydrate snacks and drinks can also be given (e.g., a rice cake, bagel, bread, or popcorn), especially as treats or a midday snack. Care should be taken not to exceed the dog's daily caloric needs. Whenever possible, a veterinary nutritionist should be consulted to help formulate the diet and provide advice concerning supplementation. In any event, the dog's veterinarian should be consulted in advance of implementing any dietary changes or supplementation in order to obtain appropriate dosages and other relevant information (e.g., potential side effects) and potential adverse interactions with other medications that the dog might be taking. For example, 5-HTP should never be given in conjunction with selective serotonin (5-HT) reuptake inhibitors or tricyclic antidepressants.

Diet Change and the Integrate-or-Disperse Hypothesis

Hennessey and colleagues (2002) have reported that a high-quality diet (HQD) with increased levels of protein (29%) and fat (20.5%) appears to produce a calming effect when combined with a social enrichment (SE) procedure, whereas a comparison diet (CD) (23.0% protein/10.1% fat) combined with SE produces a marked increase in behavioral reactivity. Pretest and posttest scores were obtained at week 1 and again at week 8. The behavioral tests consisted of the dog being left alone in a novel environment (arena), exposure to a motionless and moving stranger, the approach of a remote-controlled toy car, and the startling blast of an air horn while alone. Dogs receiving SE were given 20 minutes of dedicated attention in a friendly room 5 days per week. SE consisted of 3 minutes of moving about freely, 7 minutes of stroking and gentle efforts to make the dog lie down on a rug, and 10 minutes of training. Dogs not receiving SE remained in their kennels. The results of this study contain paradoxical and counterintuitive trends with respect to the effects of diet and SE on anxiety and fear thresholds and raise questions with respect to potential adverse effects of dietary change and SE efforts. Further, if the study reflects actual shifts in behavioral thresholds due to dietary change and SE (not an uncontrolled influence or artifact), it raises several intriguing hypotheses with respect to the effect of diet change on the dog's responsiveness to social rewards and provides experimental support for the necessity of improving the dog's quality of life as a necessary coactive factor to achieve the bond-enhancing objectives of cynopraxis (see *Quality-of-Life Matters* in Chapter 8).

The most interesting aspect of the study is the unexpected ways in which the dogs responded to SE under the influence of the

different test diets. For example, when exposed to the previously described battery of behavioral tests, dogs fed the CD and given SE (CD/+) showed more escape attempts, panting, nervous social licking, and yawning than did counterparts fed the control diet but not given SE (CD/–). In contrast, dogs fed the HQD and given SE (HQD/+) showed significantly fewer escape attempts than did dogs fed the experimental diet but not given SE (HQD/–). Whereas the HQD/+ group panted less, produced fewer yawns, and gave fewer anxious social licks, the HQD/– group showed evidence of increased anxious arousal, producing more panting, yawning, and nervous social licking. Although the HQD/+ group showed a trend toward decreased reactivity and enhanced relaxation, the HQD/– group tended to become more anxious, but remained unchanged with respect to active reactivity measures (escape attempts). On the other hand, the CD groups showed an opposite trend of divergence with respect to the effect of SE. The CD/+ group exhibited a tendency to become more reactive and anxious, whereas the CD/– group appeared to show significantly less evidence of anxiety and reactivity. Oddly, the overall scores received by the CD/– group were comparable to the scores received by the HQD/+ group. The HQD/+ group scores were only marginally better than the CD/– group in the case of escape attempts.

These results seem to indicate that dogs fed a HQD need more social attention and care than dogs fed nutritionally adequate diets. In fact, one might surmise, that dogs fed an average diet while sheltered may be more likely to exhibit adverse behavioral and emotional changes when given more attention and care, whereas dogs fed a HQD may show increased signs of social anxiety when given less attention and care. In other words, the just-adequate diet appears to promote changes that alter a dog's response to friendly social interaction, making it subsequently more reactive and anxious to social and environmental stimuli. In contrast, the HQD appears to promote increased social anxiety in dogs that receive too little friendly interaction, but yields a calming effect in the case of dogs receiving increased friendly social contact (e.g., stroking, massage, and training). As a result, one might speculate that the HQD/+ group would tend to form more rapid social attachments than the HQD/– group, whereas the latter might show a comparatively heightened reactivity to being left alone. On the other hand, the CD/– group might show a significantly decreased ability to form new social attachments, whereas the CD/+ group might be more prone to show increasing levels of social reactivity and anxiety with respect to social stimuli and situations involving close social contact. One might further speculate that decreasing the quality of the diet more in the case of the CD groups, while at the same time rapidly increasing the complexity and quantity of social interaction given to the CD/+ group, might substantially increase anxiety and frustration, perhaps producing additional social reactivity (e.g., anxious submissiveness and threats or resentment) and an increasing trend toward self-imposed isolation. How dogs react to such hypothetical changes in diet and social interaction would probably depend on individual differences, epigenetic adversity, and allostatic load. Relevantly, Kaplan and colleagues (1996) found that cynomolgus macaques exhibit significant changes in social affiliation and agonistic behavior when fed a low-fat/low-cholesterol diet. Monkeys fed the low-fat diet while living in an unstable social setting showed more overt aggression, but when living in a stable social setting with familiar conspecifics they showed both more aggression and submission behavior and spent much less time making close tactile contact with other monkeys. Kaplan and colleagues have argued that these results are consistent with the existence of a negative-feedback mechanism between dietary privation and the expression of appropriate behavioral adjustments.

Unfortunately, the study performed by Hennessey and colleagues lacks a control group for comparing the effects of the two diets and SE against a third diet (shelter diet) common to both experimental groups prior to the beginning of the study, making a com-

parison of contrast effects on behavior between the shelter diet, the CD, and HQD a matter of speculation. However, assuming that the CD was nutritionally inferior to the shelter diet and that the HQD was superior, then the changes in the dogs' behavior may be due in large measure to the contrast detected between the new diet and the accustomed one; that is, the new diets are either better or worse than the dogs are accustomed to eat. At some level, the brain may detect and respond to such discrepancies and mobilize one of two general phylogenetic survival modes (PSMs). According to the integrate-or-disperse hypothesis, if nutritional change is experienced physiologically as better than accustomed, dogs may mobilize a *social integration strategy* and exhibit a shift of priorities toward activities and exchanges leading to improved social relations and friendly proximity-seeking behavior. On the other hand, dogs experiencing the diet change as something worse than accustomed may fall under the influence of a *loner dispersal strategy*, causing friendly interaction to paradoxically lower anxiety and reactivity thresholds.

The integrate-or-disperse hypothesis postulates that dogs receiving better-than-accustomed diets tend to respond positively to close contact and cooperative interaction because such activities are consonant with the overarching integrative PSM to form friendly social relations, but such dogs may become increasingly anxious and reactive as the result of actions leading to social isolation or rejection. Conversely, the hypothesis predicts that dogs receiving worse-than-accustomed diets, resulting in the mobilization of a dispersing PSM, will tend to become increasingly anxious and reactive subsequent to actions leading to friendly social interaction, because such activity is dissonant with the dispersal PSM. Such dogs may become more relaxed and comfortable as they are ignored and left alone, that is, when engaged in activities that are consonant with the dispersal survival modes. Accordingly, actions that are dissonant with the operative integrating or dispersing PSM result in escalating anxiety, whereas actions that are consonant with the PSM result in increasing calm and relaxation. This hypothesis points to the existence of a novel form of adaptive learning, which, if confirmed, may have powerful implications for understanding the development of emotional and behavioral disorders.

Under conditions of plenty, the most serious threat that the social animal faces is the loss of a place within the social group, that is, to be shunned or ostracized. As a result, during times of plenty, a persistent failure to experience increased social and friendly contact with others may stimulate significant uneasiness, feelings of vulnerability, and despair—a desperate plea for social attention (separation distress). Consequently, dogs operating under the influence of an integrative PSM may evidence increased social tolerance, enhanced mood, readiness to integrate new friendly relations, and calmness, developing in close association with social rewards and affectionate contact between the dog and family members. However, under the influence of diminished nutrition, physiological loss, and other quality-of-life deficiencies, priorities may turn inexorably toward self-interest and dispersion as a strategy of homeostasis and survival. In addition to a reduced ability to integrate friendly relations, the loner dispersal strategy may include increased object guarding, increased territoriality toward visitors, and intolerance toward intrusion around eating and resting places. The loner dog may tend toward activities that lead in the direction of increasing solitude (e.g., social avoidance, intolerance, and irritability). Instead of experiencing tactile stimulation and friendly interaction as being emotionally gratifying, the dog may instead become increasingly anxious and agitated by such treatment, insofar as the interaction conflicts with the mobilized dispersal survival mode. Instead of producing a physiologically calming effect, such dogs may react to petting as a stressor (see *Oxytocin-opioidergic Hypothesis* in Chapter 6). Like the reactive agonism of Kaplan's macaques fed a low-fat diet, dogs showing a loner dispersal strategy may also show increasing anxious submissiveness, aggressiveness, and intolerance (reactive agonism) in response to affectionate tactile stimulation given by family members. Whereas the social integra-

tion strategy mediates social engagement (e.g., frontal orientation, sustained eye contact, whining and howling, tolerance, increased proximity, and enjoyment of social tactile stimulation), the loner dispersal strategy mediates social disengagement (e.g., sideways orientation, refusal to make eye contact, growling, increased social distance, and increasing contact aversion). The dispersing loner may show an increasing intolerance or irritability toward family members. Under the influence of the loner dispersal strategy, the dog may become more and more prone to reactive conflict and withdrawal from social contact. If pressured for close contact or interaction, the dog may become increasingly anxious, irritable, depressed, and more aggressive—an angry loner. The angry-and-depressed coping style may be an extreme example of the loner dispersal strategy, perhaps helping to make sense of the reactive aggression shown by some dogs in response to the most benign and friendly handling by family members. For such dogs, operating under an actual or perceived state of privation, affectionate contact may be paradoxically anxiogenic and irritating. As circumstances become worse, the reaction to social comfort and contact may become more and more debilitating. In contrast, as the dog's circumstances or quality of life improves, its response to social contact and its willingness to integrate friendly relations should correspondingly make progress.

Interestingly, the integrate-or-disperse hypothesis may help to explain the temporary aggression-reducing value of the social-deprivation procedure previously discussed (see *Nothing in Life Is Free, Subordinate Postures, and Rank*). By withholding social contact from a dog operating under a loner-dispersal strategy, its anxiety and reactivity may be significantly reduced as it engages in activity consonant with the dispersal ESS. From this perspective, the procedure has little to do with the idea of changing a dog's perception of rank, but may mediate a calming effect by simply leaving the dog alone and preventing it from engaging in social activity dissonant with the dispersal ESS. However, if true, the procedure works with a severe cost with respect to a dog's capacity to ultimately integrate friendly relations with the family, since it only serves to polarize the dog further. In contrast, instead of promoting social avoidance and withdrawal, the integrate-or-disperse hypothesis predicts that improving a dog's quality of life through diet, exercise, play, and minimized confinement may be sufficient to mobilize a social integration strategy, thereby reversing the dog's adverse response to social rewards and enabling it to integrate friendly social relations with family members without experiencing paradoxical anxiety.

The cynopraxic therapy process works only to the extent that both social and quality of life imperatives are satisfied, that is, the procedure used must both enhance the bond while improving the dog's quality of life. Provided that the integrate-or-disperse hypothesis is generally accurate, then gradually enhancing the quality of the dog's diet and the quality of other prominent aspects of its life would seem to be a logical and useful starting point in the treatment of CDA and other problems involving a failure of the dog to integrate friendly household relations. Even if the foregoing hypothesis concerning the precise causes turns out to be wrong, the value of improving the dog's diet and quality of life will remain a valid and useful way to initiate cynopraxic therapy.

Fat, Cholesterol, Fatty Acids, and Impulsive Aggression

In the experiment performed by Hennessey and colleagues, a significant aspect of the diet change was an alteration of fat content. The HQD contained twice as much fat as the CD together with a significant increase in protein. They found no evidence in support of the notion that a high-protein diet might promote aggressiveness or irritability. One possible alternative explanation for the benefits observed in dogs fed a reduced protein diet is the fat content of the diet. Dodman and colleagues (1996b) adjusted the energy density of their different diets by manipulating fat content. The fat content of the high (h), medium (m), and low (l) protein diets were adjusted in stepwise fashion from 27.5 (h) to

36.8 (m) to 44.8 (g/1000 kcal), respectively. Large adjustments in dietary fat content were carried out in the study performed by De Napoli and colleagues (2000). In this experiment, the low-protein diet contained five times as much fat as the high-protein diet. Although neither study controlled fat content as a potential therapeutic variable, dietary fat and cholesterol levels may exert a significant influence on serotonergic function and confound the modest behavioral effects attributed to increased tryptophan. The notion that a change in fat and cholesterol intake might influence reactivity and impulsive aggression has been a topic of considerable experimental interest, and numerous studies have shown evidence of a link between low cholesterol, reduced 5-HT activity, and various adverse impulse and mood (depression) effects, including an increased propensity for impulsive aggression (Buydens-Branchey et al., 2000; Golomb et al., 2000). As previously discussed, monkeys fed a low-fat and low-cholesterol diet are more aggressive and less friendly than monkeys fed a high-fat and high-cholesterol diet; such monkeys also have lower cerebrospinal fluid concentrations of the serotonin metabolite 5-hydroxyindoleacetic acid (5-HIAA) (Kaplan et al., 1994), suggesting a potential mechanism for the change in social agonism. Accumulating evidence appears to support the notion that low cholesterol is not merely of correlational interest, but may play a causative role in the process of producing serotonergic abnormalities (Brunner et al., 2002). The effect of fat and cholesterol on behavior and mood appears to be dose dependent, since excessively high cholesterol levels also appear to produce adverse effects on impulse control (Hilakivi-Clarke et al., 1996), suggesting that some optimal level is necessary for efficient serotonergic functioning and for producing preventive or therapeutic benefits (Hillbrand and Spitz, 1999).

Other lines of evidence suggest that low cholesterol may not be as critical a measure or predictor of impulsive aggression as low levels of omega-3 polyunsaturated fatty acids (PUFAs) (Hibbeln et al., 1998; Rogers, 2001). Omega-3 deficiencies have been identified in children exhibiting behavioral and cognitive deficits associated with attention-deficit hyperactivity disorder (e.g., learning difficulties, inattentiveness, and impulsivity) (Stevens et al., 1996), symptoms that are ameliorated by PUFA supplementation (Richardson and Puri, 2002). Omega-3 supplementation has also been shown to stabilize mood, reducing the severity of human depression and mania (Freeman, 2000). Finally, the oxidative depletion of essential fatty acids within the neuronal cell membrane has been implicated as a major factor in the progress of psychotic disorder, with supplemental PUFAs and antioxidants providing therapeutic benefits by helping to repair damage done to the cell membrane by oxidative stress (Mahadik et al., 2001). Interesting preliminary evidence suggests that supplementing the diet with PUFAs, especially omega-3 [eicosapentanoic acid (EPA) and docosahexanoic acid (DHA)] may enhance central serotonin function and reduce impulsive behavior, including aggression (Brunner et al., 2002). The clinical value of these dietary manipulations for dogs exhibiting CDA and other behavior problems has not been evaluated, but one double-blind, controlled trial has demonstrated mood-stabilizing efficacy in human bipolar patients (Stoll et al., 1999). A relatively high dose was used (omega-3 fatty acid: 6.2 g EPA and 3.4 g DHA divided in two daily doses). A recently reported trial involving briefer treatment and a lower dose of DHA alone (without EPA) proved ineffective for major depression. The foregoing data suggest strongly that cholesterol and/or PUFA plasma levels may represent a useful diagnostic marker and etiological factor in the development of CDA. Veterinary clinical investigation of cholesterol and PUFA levels in aggressive and nonaggressive dogs would seem justified.

Protective and Restorative Effects of Vitamins and Antioxidants

Dogs under chronic stress and increased metabolic strain may benefit from preventive measures taken to reduce neuronal damage due to oxidative stress. The brain may be particularly vulnerable to such damage as the

result of increased metabolic activity associated with chronic stress and the maintenance of a reactive coping style. Diets enriched with antioxidants such as vitamins C and E and alpha-lipoic acid may exert significant neuroprotective effects (Packer et al., 1997) or reverse adverse cognitive changes associated with aging in dogs (Milgram et al., 2002) (see *Diet and Exercise* in Chapter 3). In addition to potent antioxidant effects, alpha-lipoic acid has been found to increase dopamine, norepinephrine, and serotonin activity in aging rats (Arivazhagan and Panneerselvam, 2002), perhaps helping to explain some of the cognitive benefits observed in older dogs fed diets containing increased levels of the substance (Milgram et al., 2002). Vitamin C and vitamin E perform complementary water-soluble and fat-soluble antioxidant functions. Normally, a dog's need for vitamin C is at least minimally satisfied by endogenous synthesis; however, as the result elevated allostatic load, the requirement for vitamin C may increase. Also, dietary supplementation of vitamin E and PUFAs may produce an increased demand for vitamin C. Vitamin C may influence vitamin-E potency and help prevent the propagation free radicals (Mahadik et al., 2001; Milgram et al., 2002). Interestingly, vitamin C is rapidly absorbed after ingestion, suggesting that dogs may have an active intestinal transport mechanism to increase the absorption of vitamin C (Wang et al., 2001). Dogs have evolved the ability to taste furaneol, a sweet flavor associated with fruits (see *Gustation* in Volume 1, Chapter 4). The ability to efficiently absorb vitamin C combined with the presence of gustatory receptors dedicated to the taste of fruity flavors suggests that vitamin C may possess an underappreciated physiological significance for dogs.

EXERCISE

Some data suggest that exercise may exert a significant modulatory effect over biological stress as well as influence the activity of various neurotransmitter systems (see *Exercise and the Neuroeconomy of Stress* in Volume 1, Chapter 3). These general physiological effects of exercise may help to account for the lower incidence of dominance- and possession-related aggression occurring in dogs obtained for the purpose of exercise (Jagoe and Serpell, 1996). Putting a dog outside in a fenced yard or on a run line is not enough to ensure adequate exercise (Delude, 1991). To produce a benefit, the owner must become directly involved in the exercise activity, ensuring that the exercise (walking, running, jumping, fetching, and so forth) is done in way that produces physiological and psychological benefit.

BRIEF PROTOCOLS FOR CANINE DOMESTIC AGGRESSION

Assessing and modifying aggression in adult dogs is complicated by a dearth of reliable scientific and technical information with which to construct rational treatment protocols. Most of the current literature is composed of clinical impressions, case histories, anecdotes, and statistical analyses of questionnaires. Such methodology is subject to many confounding influences, not the least of which are the investigator's personal biases and beliefs. Although such information may offer promising insights from time to time, it is also prone to an opposite effect: the perpetuation of unfounded opinions and "cherished preconceptions." Few of the contemporary treatment protocols used to control or manage CDA have been subjected to rigorous clinical evaluation and validation. Clearly, much more needs to be done by way of basic and clinical research to advance our knowledge about how to best treat dog aggression problems. In any case, there are no cookbook procedures for controlling aggression, and effective intervention depends on both theoretical and applied knowledge together with competent skills and practical experience acquired as the result of treating such problems.

Assessment and Treatment Priorities

All provocative situations and control incentives that have been associated with aggressive threats or attacks in the past should be identified and evaluated (see *Assessment and Identification* in Volume 2, Chapter 8) (Table 7.4). Many domestic aggressors threaten or

bite in more than one situation. In addition to identifying the situations where aggression occurs, potential motivational factors should be explored, including emotional establishing operations (e.g., fear, anxiety, frustration, irritability, or anger). In many cases, these various emotional influences are coactive and present in varying proportions and admixtures. Frequently, domestic aggressors show evidence of fear just before or after biting, leading to a widely held belief that all such attacks are motivated by fear. Although fear appears to play an active motivational role in triggering or escalating some forms of CDA, it also exerts a strong inhibitory effect over many forms of aggression. Fear occurring just before an attack in association with threat displays may serve to stop or reduce the severity of the resulting bite, whereas fear occurring during an attack may either serve to limit the attack or cause it to rapidly escalate, as is prone to occur in response to inappropriate punishment. An aggressive dog's reliance on threat displays belies a significant amount of fear and conflict; otherwise, the dog would not hesitate and threaten before launching into an attack. The fearlessness associated with some forms of panic-related aggression may be responsible for the lack of threat and warning before a dog launches into a hard, uninhibited attack. In such cases, efforts to instill fear may worsen the aggressive response. The presence of fear in association with threats may help to explain the greater sensitivity and responsiveness of the threat sequence to the inhibitory effects of punishment. Although punishment may be more likely to interrupt and prevent an aggressive episode at the threat sequence, it does so at the risk of suppressing the threat display without reducing the dog's propensity to attack. In cases involving dogs that are aggressively reactive to fear-eliciting stimulation, such treatment also runs the risk of triggering an overt attack that might not have occurred without the punitive stimulation.

The role of fear in aggression is complicated. Fear reduction should be primarily the result of increased feelings of safety and trust occurring in association with enhanced interaction between the dog and the owner. Placing too much emphasis on fear reduction by means of situational counterconditioning efforts or medication may not significantly improve the overall situation and long-term prognosis, but may inadvertently make things worse, perhaps even more dangerous (see *Pharmacological Control of Anxiety and Fear* in Chapter 3). For example, tranquilization appears to cause wolves to become more aggressive and more likely to attack without giving threat displays (Woolpy and Ginsburg, 1967). In addition to evaluating control incentives, trainers should carefully assess and address coactive emotional factors, such as anger, frustration, irritability, and panic (loss of control). The role of fear in aggression varies significantly under influence of different control incentives and coactive emotional influences. Dogs showing fear while exhibiting aggression in the context of object guarding represent a significantly different diagnostic picture than dogs showing fear and aggression while their paws are handled. Although graduated counterconditioning is effective and can be used to reduce specific fears, behavior therapy of aggression problems occurring in associated with control-related incentives should stress training activities that teach the dog and owner how to cope more competently and confidently with provocative situations. Without such a broad-based cynopraxic approach to such problems, the dog may learn not to bite in the specific situation treated with counterconditioning, but still harbor a control-related propensity to threaten or bite the owner in other provocative situations involving other control incentives.

Many situations leading to CDA are associated with a loss of safety or comfort. Under circumstances resulting in the loss of safety or comfort, predisposed dogs may threaten or attack under varying coactive emotional influences, including irritability, anger, frustration, and fear. Both control-related aggression and panic-related aggression occur under the influence of such provocative stimulation. Dogs exhibiting control-related aggression most often present threats and inhibited punitive attacks. In contrast, dogs exhibiting

TABLE 7.4. Common situations and triggers provoking aggression in dogs

When the dog is approached while in close proximity or in possession of toys, food or food bowls, and other prized objects (possessive aggression)
When the dog is approached while occupying a resting place
When a person enters a certain room while occupied by the dog
When a person is putting a collar on the dog or grabbing the collar
When the dog's leash is yanked
When the dog threatens some person or dog but turns the attack toward someone else who is closer or attempts to restrain it (redirected aggression)
When the dog is shouted at loudly
When the dog is being forced into its crate
When the dog is physically displaced from the bed or favorite pieces of furniture
When the dog is approached while resting or sleeping in or near doorways
When the owner is leaving the home
When the dog is approached directly, reached for, or stepped over
When the dog is near a particular family member
When the dog is being picked up, manually restrained, or physically threatened
When the dog is touched in a particular place (e.g., top of head, shoulder, belly, feet, or hindquarters)
When the dog is given unwelcome affection or petting
When the dog is being groomed (brushing, trimming nails, cleaning ears, or bathing)

panic-related aggression show a significant degree of dyscontrol over aggressive impulses, representing a significantly more dangerous problem. Panic aggressors often appear to attack incompetently and impulsively, reacting in the most violent and uninhibited ways to the most innocuous and trifling intrusions or interferences disturbing their comfort or safety. Such dogs seem to lack a normal degree of social flexibility and tolerance. Panic-related attacks frequently occur under the prompting of heightened autonomic reactivity, anger, fear, rigidity, and the momentarily loss of impulse control. In contrast to control-related and avoidance-related aggression, panic-related aggression appears to occur as the result of an incompetent loss of impulse control. Physical punishment in such cases serves only to further heighten aggressive arousal, perhaps because of a fear-mediated excitatory influence on anger/rage circuits.

Domestic aggressors often show affection toward their victims, but appear to tolerate innocuous intrusion, interference, or loss. Without the formation of an affectionate bond based on trust, the daily interaction between the owner and the dog may be vulnerable to the adverse effects of interactive conflict and stress. The resulting stress-related autonomic and behavioral changes may contribute to the development of CDA. Some domestic aggressors show a persistent intolerance to the affectionate and playful overtures of certain family members while tolerantly accepting the affection from others. In addition to showing intolerance and increased irritability, these dogs may show varying levels of resentment toward physical handling and control, increased emotional reactivity and vigilance, rigidity, and a lack of responsiveness to play. Such dogs appear to actively resist the rejected family member's efforts to establish a close connection and may deliver a hard bite while being hugged or petted affectionately. In the absence of affectionate trust or willingness to form an affectionate relationship, pet-

ting, handling, and invitations to play might naturally become sources of resentment and irritation and, in some cases, set the occasion for aggressive reprisals (see *Loss of Safety, Depression, Panic, and Aggression*).

Aggression Associated with Disturbances While Resting

Dogs exhibiting aggressive tensions, threats, or overt biting when approached while in certain locations, such as doorways, near feeding areas, or beds, should be trained to leave such areas by vocal and hand signal, rather than reaching for them or attempting to displace them manually. Cooperative compliance at such times is appropriately rewarded with affectionate vocal encouragement and food rewards or by providing the dog with activities that it enjoys (e.g., going for a walk or play). Eventually, the dog acquires a something-positive-is-about-to-happen-to-me expectation whenever the owner approaches. Training a dog to orient in response to its name and to hold its attention briefly on the owner is an important aspect of this training process. The orienting and attending response is repeated frequently from different directions and while approaching the dog in different ways. The dog gradually learns to orient and make sustained eye contact with the owner before being rewarded. Various types of approaches including slow, normal, and fast movements toward the dog are associated with the sequence of calling its name, holding its attention, and tossing it a treat. In some cases, a squeaker containing an odor previously paired with PFR training is used as an orienting stimulus—a procedure that is especially useful while working with a dog at close quarters or when prompting it from a hypnagogic or sleeping state. The odor provides contextual and associative information stemming from PFR training that may compete with or restrain aggressive arousal. Alternatively, during approach and attention therapy, the odor can be put on hands and clothing or sprayed into the air by a plant mister or a modified carbon-dioxide (CO_2) pump. At times when the dog must be awakened, its name is called or the squeaker is used. Orienting and attending training helps to condition a positive anticipatory response in association with being awakened or disturbed. The orderly presentation of training events associated with attention therapy serves to enhance executive control over impulse. Attention therapy also improves the likelihood that a dog is orienting and attending to training events and getting the most from counterconditioning and other behavioral procedures.

Dogs that threaten or bite if they are disturbed or moved while resting or sleeping should also be trained to defer to command in situations where they have exhibited aggression in the past. Frequently, these locations involve furniture or a bed, but it can be any place where the dog habitually rests, including the owner's lap. In addition to preliminaries already discussed, such dogs should be trained to surrender defended areas on the command ("Off") and do so without hesitation or resistance. Such training is performed with the dog kept on leash and collar or halter to make handling and control more safe and effective. The dog is trained to both jump onto ("Hup") and off furniture in various locations around the house. The on-off ritual is repeated until the dog's performance is fluid and brought under the control of both voice command and hand signal. Initially, the dog is prompted to leave furniture by gesture or by tossing a treat some distance away, requiring that it get up to retrieve the food. Tossing a ball or some other valued toy can also be used to prompt the off action. The hand movement used to toss the treat is incorporated as a hand signal by gradually fading the treat. As the dog takes its reward for getting off, it is called back and prompted by gesture to jump back up on the furniture and rewarded again. Other resting places associated with previous threats or attacks should be identified and treated in a similar way. If the dog shows overt aggressive actions, it is appropriately directed off the furniture by leash and hauled off to TO. Once a dog is trained to jump on and off furniture, the owner should allow the dog to get up on furniture only after it sits and waits for an invitation to jump up. Dogs that have seriously threatened or have bitten while on a bed

should be restricted from such access and learn to sleep on the floor or in a crate, if necessary.

Aggression Associated with Social Signals and Intrusive Movements

In addition to training the dog to perform various cooperative behaviors incompatible with aggression, the predictive and emotional significance of social signals are modified by linking them with prosocial exchanges incompatible with aggression. Social signals provide the dog with predictive information about what is most likely to occur in the immediate future, thereby motivationally preparing it to cope effectively with the impending social situation (see *Social Communication and the Regulation of Aggression*). For example, some dogs by virtue of severe or repeated noncontingent punishment in the past, may become aggressively aroused when exposed to social and contextual stimuli that resemble those present at the time of event. A wide variety of social signals occurring immediately before the event may acquire provocative significance via classical conditioning, including loud voices, staring, the smell of anger, standing over, raised hand, quick movement, reaching actions, grabbing, or touching, and patting. Many of these social signals (e.g., loud voices, fast movements, and smells of anger) may be biologically prepared for rapid conditioning and the formation of associative linkages with anger and fear. As a result of such conditioning, subtle and benign movements may provoke aggressive arousal, especially when they occur under the influence of contextual cues similar to those present at the time of the original provocative event. In addition to external contextual stimuli, internal contextual stimuli consisting of mood and emotional changes also contribute to setting occasions in which aggression is most likely to occur. Together with external and internal contextual cues, the dog's activity and body posture at the time of the event may have been strongly associated with the traumatic event. After identifying these various provoking social and contextual stimuli, they are hierarchically organized in accordance with their provocative potential. The preparatory aversive arousal associated with these various stimuli and contextual settings is gradually modified by a pattern of rewarding and safe exchanges that promotes social expectancies and emotional establishing operations incompatible with reactive arousal and aggression.

Aggression Associated with Guarding and Possessiveness

Possessive guarding of food and toys is a common dog aggression problem. From the results of a large survey (N = 3226), Guy and colleagues (2001a) found that approximately 20% of dogs either growled or snapped while in possession of toys, food, or other objects. Dogs are often highly selective about the sort of items that they defend, and removing those items from the house can be a helpful preventive measure. Object guarding and possessiveness are not necessarily indicators of dominance, even though superficially the behavior appears to be motivated by dominance-related incentives. Among wolves, there is little correspondence between object guarding and dominance, with wolves of all ranks exhibiting heightened possessiveness over objects located within their ownership zone around the mouth. In addition, all wolves, regardless of rank, will attempt to steal food from other wolves irrespective of dominance (Mech, 1999). Competition between the owner and the dog over the control of forbidden objects appears to magnify the perceived value of the objects and to promote guarding incentives. A history of chasing, cornering, capturing, restraining, punishing, and the forceful extraction of objects from the dog's mouth may stimulate a problematic control incentive associated with possessions, especially involving objects possessing significant appetitive value for the dog. The appetitive motivations associated with guarding behavior suggest that the behavior is not under a strong influence of fear, but is primarily associated with comfort-loss incentive under the coactive influences of anxiety, frustration, and anger. Dogs affected by low anger/rage thresholds and high excitability levels are particularly prone to serious aggres-

sion problems occurring in association with object guarding.

Dogs that grab, run off, and guard objects frequently exhibit aggression problems involving hard bites to family members, and these problems require significant retraining and owner education to resolve. Such dogs should not be chased or challenged when they possess objects. The best method for the treatment of such problems is prevention. A high correlation seems to exist between the activity of grabbing forbidden objects and provoking a chase-and-evade game with the owner and the later development of object-related aggression. Puppies and dogs that engage in this sort of behavior should be encouraged to bring such items back to the owner in exchange for a treats and other rewards. Dogs that refuse to exchange an object for a treat can often be enticed to come by ringing a doorbell, shaking a set of car keys, or picking up a leash. Once the object is retrieved, the dog is put on a leash as necessary for added control and safety, and the forbidden object is placed on the floor with the voice signal "Leave it." If the dog approaches the object, the trainer says "Leave it" in a firm voice and, if necessary, prompts the dog with the leash to leave the object. If the dog turns away from the object, it is rewarded with praise, food, and an alternative item that is both acceptable for chewing purposes and attractive for fetching. This general procedure is repeated until the dog avoids the object in a variety of situations. The subsequent steps in this process are described in Chapter 2 (see *Controlling Inappropriate Chewing Activities*).

Dogs that show a guarding response while eating represent a significant threat to family members, especially young children who may not be appropriately respectful of the dog's need for space while eating. Again, prevention is the key to avoiding such problems. The common practice of repeatedly taking a puppy's food bowl away while it is eating does not appear to be useful and may actually make matters worse. The best strategy is to train the puppy to expect that it will get something, rather than lose something, when it is approached while eating. Feeding each meal in several small portions appears to help reduce negative tensions around the food bowl. Feeding with two bowls can also be used in a similar way, allowing the owner to place food unobtrusively into one of the bowls while the dog is eating from the other one. Changing the type of food fed, the type of bowls used, and the schedule and location of feeding may help to reduce stimulus and contextual cues associated with possessive reactivity. In some cases, decreasing the appetitive value and palatability of the food may help to reduce the dog's incentive to guard it. The trainer can restrain the dog on leash or tie-out and use a probe stick or broom handle to move the food bowl away from the dog, thereby getting some indication of the dog's level of reactivity. The absence of an aggressive response to such intrusion is not necessarily a reliable indicator of safety from a potential attack, however. Dogs showing food-guarding reactivity should receive intensive basic training and exposure to various object-guarding techniques and restraint measures as needed to reduce reactivity occurring in association with intrusions while eating. At a minimum, such dogs should be kept on leash and trained to wait in a sit-stay before being released on cue to eat. They should also learn to leave the bowl on voice command and wait at a distance as an attractive food item is put into the bowl, whereupon they are released to take it. When approaching a dog while it is eating, the practice of tossing food items of varying value near or into the food bowl can also be helpful. Food guarding should be treated with a high-degree concern and with many of the same precautions and techniques described for object-guarding behavior. Although many of these dogs limit their agitation to becoming uncomfortable, stiff, and vigilant around the bowl, some excitable and highly food-motivated dogs have delivered severe and unexpected attacks following a history of low-grade threats and snaps. Dogs that are given training before they reach the stage of hard biting appear to be significantly less likely to escalate their aggressive efforts around food. Food guarding can be managed by simply avoiding contact and not interfering with the dog while it is eating, except as required for countercondi-

tioning efforts. Dogs that show a high level of agitation while eating should be fed in a separate room from people or other dogs or crated as a further precaution and safety measure.

Object guarding is a common source of dangerous control-related aggression. Attacks associated with possessive aggression present with a great range of potential danger and variety, requiring careful assessment and evaluation that take into account the risk of future attacks against family members. Object guarding and possessive aggression are particularly problematic in busy households with children and visitors who may inadvertently come into contact with the possessive aggressor while it is in possession of a protected object. Severe object-guarding threats and biting sometimes occur without much warning in response to minor intrusive threats. Other dogs attack with inhibited snaps or bites only after a significant amount of intrusive interference has transpired around the protected object in the presence of various threats and warnings by the dog. Dogs exhibiting the first pattern of object guarding in association with hard biting present a guarded prognosis and should be removed from homes with children. The second group of dogs are generally more responsive to training efforts, but may still represent a significant threat to children or others coming into contact with them under adverse circumstances. Although such dogs may pose a risk, it is often one that can be managed with common sense, conscientious precautions, and a lifelong commitment to the dog's training. Hard decisions sometimes need to be made regarding object-guarding dogs, and those decisions should error on the side of safety, especially in the case of children. Object-guarding aggression has resulted in severe and disfiguring facial bites suffered by children while they were innocuously reaching toward, leaning over, snuggling, or playing tug with an object-guarding dog. A dog that has delivered an uninhibited hard bite in the context of food or object guarding should be considered prima facie at risk of biting under similar circumstances in the future; no matter what treatment is used to control the behavior and no matter how successful it appears to be, the risk may continue permanently despite the appearance of improvement.

Object guarding can be divided into five stages of escalating threat and propensity for attack: conflict, challenge, critical point, crisis, and panic. These stages are exhibited in varying degrees by food- and object-guarding dogs. Approaching an object-possessive dog while it is occupied with a prized object often causes the dog to slightly or greatly stiffen with anticipation of interference—the first overt sign of aggressive tension. The stiffening response reflects conflict-related autonomic change elicited by an expectancy of impending loss. Conflict associated with anticipated loss is followed by the dog picking up the object and evading the owner or remaining near the object, possibly under the influence of a mounting control incentive as the owner gets closer. As the owner approaches beyond the conflict point, dogs prone to guard and defend objects show an increasing anticipatory vigilance and readiness to resist or challenge the owner. If the owner advances closer and reaches toward the dog, the challenge is brought to a critical point with the dog making a rapid choice to allow the owner to intrude safely or to intensify the rising threat, sometimes leading to a sidelong preemptive snap or loss of nerve and retreat with the object. If the dog intensifies the threat, what occurs next depends on how the owner responds. If the owner backs off, the dog's guarding response may be reinforced, thereby strengthening guarding and other behaviors operating under similar control-related incentives in the future. If the owner persists and intrudes further or attempts to take the object, the dog may deliver a protective snap or bite. In the case of highly reactive and incompetent dogs, a panic point may be rapidly reached that causes the dog to dramatically intensify its threat or compels the release of a hard and uninhibited bite. From the critical point forward, the situation becomes progressively problematic, finally becoming a no-win situation. Punishment at any of these points may result in a rapid escalation and worsening of the problem. Following punishment, the protective response may occur at an earlier point in the sequence (e.g., conflict or

challenge) or else cause the dog to inhibit threats until a crisis or panic level of arousal is reached, thereby possibly making the attack more dangerous and difficult to anticipate. Instead of excessive reliance on confrontational procedures, various behavior-therapy techniques can be used to reduce guarding behavior by means of counterconditioning, response prevention, and training the dog to relinquish objects under a positive expectancy of gain by way of reward rather than loss.

Dogs that persistently guard objects may require intensive preliminary basic training and behavior therapy to establish a reliable willingness to relinquish guarded objects. At minimum, the dog should receive several sessions of attention conditioning, sit-stay and down-stay and back and wait training, and be trained to take, fetch, and release toys that have not been protected in the past. A major focus of therapy is to facilitate a bond of trust that is incompatible with autoprotective incentives. The object-guarding dog is kept on leash and limited-slip collar or muzzle-clamping halter during all training procedures. Dogs exhibiting a serious potential risk for aggression should be restrained on a tie-out or active-control line during graduated challenges. An active-control line is made by hooking a carabiner to a loop of nylon that has been fastened to some immovable object (see *Walking Stand-Stay and Distance Exercises* in Chapter 1). Alternatively, a heavy eyehook can be screwed into sturdy molding. Depending on need, a 6-foot leash or a 15-foot long line is passed through the eyehook and attached to the dog's collar or halter, thus securing active control over the dog while performing object-guarding procedures. By pulling back on the line, the dog is turned away from the object and forced toward the anchored eyehook. An additional safety consideration is to attach a length of light rope to objects before presenting them to the dog (object line), thereby preserving a means to take objects away from the dog with less risk of getting bitten in the process.

Training is initiated with attention therapy and reward-based ICT. With a foundation of enhanced attention and impulse control, the object-guarding dog is first trained to take and then release various objects in exchange for a treat. Objects are introduced in accordance with their potential for provoking a guarding response. Training the dog to release objects should begin with objects that the dog is least likely to guard and then gradually moving to items that it is more likely to guard. Slowly progressing through these items without evoking threats makes the process safer and more likely to succeed. The first step is to train the dog to take ("Take it") and release a neutral item (e.g., a toy) to the hand ("Out") or to the floor ("Drop it"). With the object in the dog's mouth, the trainer says "Out" as a closed hand with a treat in it is presented to the dog. As the result of preliminary basic training, most dogs will release the object in order to obtain the treat. The size and type of food reward should be varied, but all treats used during such training should be highly attractive to the dog. After eating the treat, the object is given back to the dog after it sits on command and waits for a variable length of time. In cases involving a greater threat, the dog is trained to back away from the object after dropping it and to sit or lie down before it is rewarded. With the dog in the sit-stay (a response that should be well conditioned in the context of preliminary attention training), the trainer picks up the object, rewards the dog with a treat, and then returns the object to the dog.

The backing, sit or down, and waiting responses are facilitated by attention-controlling prompts delivered by means of the control line. These various responses should be brought under appropriate vocal and hand signal control (e.g., "Back," "Stay," "Wait," and "Take it"). The next step is to prompt the dog to remain in a sit or down-stay by saying "Stay" as the valued object is tossed out of its reach. If the dog moves toward the object, the action is abruptly blocked with the control line, and a confident vocal command "Stay" is delivered. During the brief waiting period, the dog is prompted to turn its attention toward the trainer in response to a smooch or squeaker sound, followed by a click, flick of the right hand, and the delivery of a food reward. Finally, the trainer retrieves the object and gives it back to the dog as a

reward for its cooperation. The dog is also trained to pick up objects, drop them, and back away from them or, if the dog refuses to pick up objects, it is trained to back away from a tossed object, whereupon the trainer retrieves it and gives it to the dog. Whenever safe to do so, the dog should be trained to play a tug-and-fetch game with a variety of items, thereby helping to reduce competitive tensions while increasing cooperation and trust. After the item is dropped, the trainer signals the dog to "Back" and repeatedly tugs into the control line to prompt the backing response. If the dog refuses to drop the object after picking it up, it is pulled gently from its mouth by the object line. As the object is released, the dog is rewarded and then prompted to back away. If the dog refuses to release the object, the control line is pulled back as the object line is pulled harder, as necessary to compel the dog to release the object. The dog is always rewarded after releasing the object, often by allowing it to approach and take the object on signal or by tossing the object for the dog to fetch. This general procedure is repeated until the dog releases the item without objection or hesitation and backs away under vocal command and hand signal. Delayed prompting and fading of the control line together with various startle-type tools and strategies, as needed, are used to gradually achieve the backing and stay response. To be effective, these procedures require a high degree of diligence and daily practice and a strong foundation of basic training. Owners not likely to follow through with the dedication needed to succeed or lacking the necessary aptitude should not be encouraged to pursue it in the first place.

As the dog's response improves, progressively more natural circumstances can be introduced until it readily drops and backs away from objects on command. In cases where risk permits, daily object play involving tug-and-fetch games and variations on the release, sit-stay or down-stay, attention, wait, back, and fetch modules and routines should be practiced in the context of nonthreatening retrieve games with objects that the dog is unlikely to defend.

In some cases, once preliminary training has been successful, remote training (electrical and spray devices) can be used to establish a higher level of compliance over the dropping, backing, and the stay responses. Such training should involve a competent introduction of remote training in advance of using electrical stimulation to control possessive behavior (see *Electronic Training and Problem Solving*, Chapter 9). Remote electronic training can help to enhance impulse control while appearing to produce beneficial secondary effects conducive to the enhancement of relaxation and safety (Tortora, 1983) and to enforce compliance once behavioral control has been established via reward training (Borchelt and Voith, 1996). A significant advantage of electrical training for managing aggression problems is that it can be used to capture a dog's attention and reliably prompt behavioral adjustments at a distance and without necessitating that the trainer make risky direct contact with the dog. Radio-activated electronic devices can deliver a controlled motivational state conducive to inhibition, but without associating the event with the trainer as the source, something not possible in the case of interactive punishment. Also, the stimulus remains consistent, steady throughout, and inescapable by means of aggressive reprisals, thereby minimizing the risk of reinforcing undesirable behavior.

The dog first learns how to escape a low-level electrical stimulus and then to avoid stimulation by performing various responses in accord with vocal commands, hand signals, and prompts (see *Remote Electronic Training* in Chapter 9). Special emphasis is placed on attention training, stay, recall, and the enhancement of emergency exercises (e.g., quick-sit and instant-down). With every successful escape or avoidance response, petting and massage are given to overlap with relief and safety from the electrical stimulus. In addition to relief and safety, the discontinuation of the electrical stimulus results in a progressive state of increasing relaxation, an opportune source of stimulation conducive to social-contact tolerance. As the result of orderly electrical training, a dog gradually learns that it can predict and control the aver-

sive electrical event by responding cooperatively to the trainer's signals and prompts. These various skills promote increased social competence, confidence, and relaxation in the dog, thereby helping it to learn how to cope in a more constructive and organized way when faced with other forms of provocative social stimulation involving threats of comfort or safety loss. Electrical stimulation can also be used in the context of back, wait, and halt-stay training. With such preliminary training in place, the electrical stimulus can be introduced into the context of object guarding, as a means to compel the dog to drop, back away, and stay at a distance from guarded objects until it is released by the trainer. With the offset of stimulation, an immediate relief response is followed by a slower and progressive relaxation response. During the course of relief/relaxation, the trainer provides the dog with vocal reassurance, petting, and massage, as can be safely performed. An olfactory safety signal can be presented at such times for the purpose of capturing and generalizing the safety-relaxation effect to other situations in which such a conditioned modulatory effect might helpful. The odor is further conditioned in association with PFR training and used in the context of graduated counterconditioning efforts. Of course, appropriate restraint (e.g., limit-slip or muzzling-type halter) and other safety precautions need to be taken at all times when working with a potentially dangerous dog (secure tie-out or active-control line). Electrical training in the context of managing aggressive behavior should be performed in the spirit of opening a window of opportunity for additional reward-based training activities aimed at conditioning behavior incompatible with aggression. The foregoing is a brief overview of steps used to manage one form of control-related aggression involving refractory object guarding. As a last resort, such training may produce a significant benefit when applied in conjunction with complementary behavior-therapy techniques. The procedure requires a high degree of skill and experience with dog aggression and electronic training and should be attempted only under the supervision of a highly skilled applied dog behaviorist or cynopraxic trainer well versed in such training procedures.

PART 3: CHILDREN AND DOG AGGRESSION

Infants and Dogs: Toward the Prevention of Problems

Dogs exhibiting active aggression problems represent a significant risk to children living in the household. Whenever possible, dogs exhibiting an excitable and reactive temperament with a demonstrated propensity to bite should be removed from homes with children. These dogs often do well in homes with adult owners, and rehoming should always be explored before more drastic measures are considered (see *Evaluating the Risk* in Volume 2, Chapter 6). Although such dogs represent an unacceptable threat to children, the majority of dogs are friendly and gentle companions for children. Even so, precautions should be taken to prevent interaction between children and dogs that may lead to an increased risk of biting or injury associated with inappropriate intrusiveness or overactivity.

Trainers are often consulted for advice regarding the best ways to introduce an infant to the family dog. The key to making this critical transition a successful one is careful preparation in advance of the infant's arrival. These preparations include selection, socialization, basic training and behavior management, counterconditioning and desensitization, exposure-habituation, and establishing a daily routine consistent with the way things will be when the baby comes home.

Selection

Advanced preparation begins with the selection of the dog. Thoughtful breed and breeder selection can help to reduce the risk of problems by increasing the likelihood that the dog is successfully matched to the owner's level of dog savvy and the needs of the household. Selective breeding has resulted in significant alterations in behavioral thresholds and temperament traits. In addition to breed-specific characteristics, individual differences predispose dogs toward behavior conducive to

interaction with children or not. Obviously, highly excitable dogs bred for wariness and guarding behavior, or those exhibiting reactive fear, aggression, or a strong predatory drive, represent a much greater risk of showing problem behavior toward children than dogs exhibiting a more calm, playful, and friendly temperament (see *Evaluating the Risk* in Volume 2, Chapter 6).

Socialization

Perhaps the most important single factor influencing an adult dog's positive reaction to a baby or child is a history of positive socialization with children. Couples who plan to have children should make an effort to socialize the young dog with children of various ages. Allowing children to pet quietly and gently or give the puppy food can be very helpful. However, allowing a wild group of screaming kids to mob the puppy is certain to have an opposite effect on the puppy's expectations and future response to such contact, possibly causing it to become fearful of children. Another way to socialize a puppy with children is for the owner to baby-sit, thereby allowing the puppy to interact with children in the context of the home. Socialization experiences of this sort probably benefit the children as well, especially if they do not have a dog of their own, since previous noneventful contact with dogs appears to exert a preventive influence on the development of a fear of dogs by older children and adults (Doogan and Thomas, 1992).

Basic Training and Management

The importance of appropriate obedience training cannot be overemphasized. Basic training is essential, especially in the case of dogs exhibiting impulsive or hyperactive behavior. Dogs showing excitable tendencies should be exposed to intensive attention therapy, recall to front-and-finish, starting exercise, following, controlled walking and quick-sit, off, leave it, back, wait, go-lie-down, and down-stay training. All of these modules and routines should be practiced to a high degree of proficiency in advance of the baby coming into the home. The dog's overexuberance during greetings and full-tilt rampages through the house and garden represent a considerable risk of injury for a baby or toddler.

Managing an overactive dog includes the provision of adequate daily exercise (including walks, jogging, and ball play), basic training, and necessary restraint and confinement (see *Hyperactivity and Social Excesses* in Chapter 5). The skills learned during basic training provide the owner with the means to control the overactive dog effectively in everyday situations. Whether it is done privately or in class, training should be initiated long before the baby's arrival and should continue for several weeks thereafter. Training should include practicing basic exercises while the owner is engaged in activities that mimic actions and situations that are likely to occur with the baby in the home. For example, the owner should have the dog perform exercises such as sit-stay while the owner is holding a doll wrapped in a towel or while rehearsing a diaper change. Also, the dog should be trained to walk next to a stroller until it becomes comfortable with its sound and movement. This should be done before the baby is actually placed inside of it. Practice should include exiting and entering the home, getting into and out of the car, and other likely situations that will regularly occur with the baby and dog in tow. An extremely useful way to enhance control during walks is a hip-hitch with a control lead and fixed-action halter collar. If halter use is planned in the context of introducing the dog to the baby, it should be slowly introduced in association with reward-based training.

A high chair should be set up, with food, bibs, towels, and other items placed upon it that might be present when the baby is being fed. The dog should be trained to avoid jumping up on the high chair in the owner's presence and absence, thus probably requiring some form of appropriate booby trap. Further, the dog should learn not to jump up on people or furniture (bed, sofa, chairs, etc.) without permission, thus preventing potential incidents involving the dog stepping on the infant while he or she is in the mother's charge being fed or changed. An overly active

dog should be routinely constrained to wait outside of the kitchen until released to enter on the owner's signal. If necessary, gates or crate training may be introduced to facilitate a safer transition.

Competition around passageways should be systematically discouraged by training the dog to defer to the owner's entitlement to enter first or to move ahead only if prompted to do so. Similar practice efforts should be carried out around the front door and back door, with bolting being vigorously suppressed with appropriate leash training. The active dog should received focused training around indoor and outdoor steps, learning to wait or to move ahead of the owner on signal, but never charging ahead without the owner's consent. Again, such training efforts as just described should be introduced long before the baby comes into the home.

Exposure, Counterconditioning, and Habituation

Fearful dogs should receive intensive behavioral training and conditioning aimed at increasing their confidence and tolerance toward children and their actions. A fearful dog, appropriately restrained on leash and collar or halter, should be exposed to structured social encounters with children of all ages. During such counterconditioning efforts, the dog is prompted to sit and relax by giving it food and petting while in close proximity with children (see *Social Fears and Inhibitions* in Chapter 3). The owner can also mimic some of the sounds and awkward movements of the baby or toddler. For example, the dog should be exposed to having its ears, tail, and other parts of its anatomy grabbed and gently pulled, thereby simulating the touch and handling of a curious child. Such handling exposure should be performed in association with appetitive counterconditioning or with the dog in a relaxed state induced by PFR training. The fearful dog is gradually exposed to a wide variety of situations involving children both in the home and away from home. Again, babysitting an infant would give the dog a chance to learn about babies, thereby possibly helping to mitigate problems later on. Fearful dogs exhibiting a demonstrated propensity to snap or bite rather than retreat from children should be removed from the home.

Habituating a dog to new sounds and smells associated with a new baby in the home may also be useful (see Appendix C). This ought to include "pretend" activities in which the expectant mother holds a doll wrapped in a blanket while changing it, applying various oils and powders. It is useful to play tape recordings of an infant crying and other sounds occurring during such activities in order to make the situation more realistic. Items imbued with the baby's odor (e.g., clothing or blankets) should be brought home from the hospital in order to allow the dog to habituate gradually to the various olfactory stimuli associated with the infant's presence.

PFR training is a central part of the dog's preparation for the baby's homecoming. The PFR cycle can be carried out with small amounts of the various odors (oils and powders) scenting the owner's hands. As the massage progresses from day to day, the recorded sounds of a baby crying can be played at progressively increasing volumes, emanating from different parts of the house. A conditioned odor [e.g., dilute (1:30–50) orange, lavender, or chamomile] can also be introduced in association with PFR, first introduced as an olfactory signature at the end of the cycle and then using it to help consolidate the relaxation response by presenting it at progressively earlier steps in the PFR process. The massage should result in deep relaxation, at which point the right hand is gently cupped over the dog's nose for a brief moment, causing it to sniff the odor. The dog is petted over its entire body, carefully following the lay of the coat, and, at last, released with a quiet clap of the hands and "Okay." With the baby's arrival, blankets and clothing imbued with the child's scent can be brought home and paired in a similar way with deep relaxation and feelings of comfort.

The dog should be familiarized with the baby's room and permitted to investigate freely, but access to the room should never be allowed in the owner's absence. Booby-trapping the doorway of the baby's room may

provide additional inhibition about entering the room without supervision. Otherwise, the room should always be gated or closed. In general, a baby should never be left alone with a dog.

Establishing a Routine

The owner should establish a daily routine of activities prior to the baby's arrival that reflects realistic estimates of time available to dedicate to the dog when the baby comes home. To ensure a successful transition, this allotment of time should not be significantly changed. The daily schedule should include sufficient time for training, exercise (at least 20 minutes twice a day), and affectionate attention. Daily walks are a good postparturient activity for the new mother as well as a positive activity for the infant and dog. Perhaps even more important than the amount of time given to the dog, the quality of interaction should not be compromised or become superficial. There is a natural tendency to turn affectionate contact away from the dog and to redirect it toward the infant. The ensuing neglect of the dog's social needs for daily affectionate contact may stimulate insecurity and prompt intrusive efforts to gain contact and attention by undesirable means.

INTRODUCING BABY AND DOG

First impressions are lasting. It is imperative, therefore, that the first meeting between the dog and the baby occur without incident. Many techniques are available to help ensure an uneventful introduction. The usual method involves having the mother enter the home *without the child* in her arms. After the initial excitement has dissipated, the dog can be familiarized with various items containing the baby's odor while being fed treats and affectionately petted. After a brief period, the leashed dog can be permitted to sniff the blanket covering the baby while continuing to receive treats.

Whenever possible, however, the baby should be introduced while the dog is preoccupied on a walk away from the property together with the mother and a helper holding the baby. This procedure minimizes a number of natural tensions that are prone to occur if the baby is taken directly into the house, especially in cases involving a dog that is unfamiliar with infants. The most common reaction by far is curiosity, but sometimes the dog is alarmed by the "strange creature," resulting in nervous growling or barking. This is definitely a result that one would wish to avoid. Going for a walk serves to distract the dog from the baby's presence, which is overshadowed by the excitement of being outdoors. Under such conditions, the dog's curiosity and potential anxiety are reduced to a more manageable level. If the dog becomes overly excited, it should be prompted to sit and thereupon rewarded by the owner with affection and food. After the dog has calmed down and settled into the walk, the mother can take the child herself and hand over control of the dog to her helper for the remainder of the walk.

Upon returning to the house, the dog is required to wait before entering, allowing the mother and baby to enter first, followed momentarily by the helper and dog. The leashed dog is permitted to smell the covered child and given numerous treats and vocal encouragement so long as it remains low-keyed and calm. With things going well, the dog may be engaged in normal play and affectionate activities, first with the helper and then with the mother. Lastly, the dog is fed while the mother attends to the baby nearby as though nothing very remarkable has taken place. The leash and collar should remain on the dog during the next few days for added control and safety.

Although every effort should be made to make the transition a positive one, limits should be immediately and clearly set, if necessary, especially in cases were the dog becomes overly pushy or demanding. If necessary, such dogs should be kept on a fixed-action halter for added control and safety. Repeated and brief TO (30 to 45 seconds) with intensive time-in reward training (orienting, attending, sit and down, and stay) can be used to help reduce arousal and impulsiveness. Behavior to be particularly on guard

about involves excessive efforts to poke and smell, jump up, or to grab at the baby's blanket. Such behavior can be discouraged with a split-second hiss with a modified CO_2 pump dry-loaded with a dilute conditioned odor (e.g., cedarwood-eucalyptus). The conditioned odor is delivered with stealth (e.g., under the jaw or from behind) and at pressure appropriate to the dog's response to the hiss-type startle (see *Olfactory Conditioning and Excessive Biting* in Chapter 6). The conditioned odor and modified CO_2 pump can be used to help set limits around undesirable household behavior requiring mild inhibitory conditioning to control. If a modified CO_2 pump is used, it should be introduced in advance of bringing the baby home, giving the dog a chance to become familiar with the treatment strategy.

In some cases, an overly excitable dog can be restrained on a tie-out or active-control line while being introduced to the baby. The mother and child are seated on the floor some distance away while the helper gives the dog treats as the two gradually inch forward in progressive steps toward the dog until they are situated just in front, where the dog receives food and affection from the mother and is permitted to smell the baby's clothing (see *Graded Interactive Exposure* in Chapter 3). An alternative method involves giving the dog a hollow rubber toy stuffed with a piece of bread smeared with peanut butter. During such graduated exposures, the helper can initiate a cycle of massage and introduce odors previously association with PFR training, thereby helping to recruit a relaxation response in association with petting and massage. The conditioned odor can be delivered by means of scented tissue or a squeaker bulb with the squeak valve removed. As the dog calms down, the child's hand can be placed in the middle of the mother's hand and held in front of the dog's nose, allowing it to sniff in association with reassuring talk and petting. This procedure is repeated several times and then as needed to relax the dog when it becomes overly excited.

Another strategy involves having the dog live somewhere else temporarily and then to habituate it slowly to the presence of the child over the course of 2 or 3 days. Initially, the owner can spend time with the dog alone, reviewing obedience work with a doll wrapped in the baby's clothing, either carrying the doll or pushing a stroller. These practice sessions can be followed by controlled meetings between the dog and the baby, at first outdoors and then inside the home. A conscientious effort should be made to establish positive associations with the baby's presence, including the provision of affection, treats, toys, and other sources of pleasure for the dog. Ideally, the dog should learn to anticipate attractive and pleasurable outcomes whenever the baby is brought into its presence. Although temporarily housing the dog elsewhere is sometimes very useful, it is far better not to remove the dog from the home situation, but to make the necessary arrangements and efforts to work things out while the dog remains in the home.

The Toddler and Increased Risk

As the child becomes ambulatory and begins to explore the dog with clumsy hands and awkward movements, new opportunities for disaster inevitably follow. Naturally, with the advent of such increased interaction, a greater risk presents itself that the dog will resent such contact or become progressively intolerant of it, possibly resulting in aggressive threats or snaps. Dogs that are possessive toward food, toys, or places are particularly dangerous around toddlers. Not surprisingly, toddlers are a common target of aggressive attacks, with boys being bitten much more often than girls (Harris et al. 1974; Wright, 1991). This difference may be attributable to the male child's greater tendency to engage in risk-taking behavior (Ginsburg and Miller, 1982). Another possible explanation is that boys may simply spend more time interacting with dogs than girls do (Lehman, 1928). Dogs exhibiting irritable or possessive aggression toward the child should be removed from the home.

The most significant threats at this age are generated by the child's failure to recognize and respect the dog's needs for space and gen-

tle handling. Although children exhibit increasing evidence of empathy by years 3 and 4 (Love and Overall, 2001), the display of these sensitivities is not particularly evident in the relentless teasing and torment that a young child can inflict upon the family dog. Children aged 2 to 3 appear to exhibit the highest frequency of provocative behavior toward dogs, making close supervision of child-dog interaction especially critical during this age period. Children aged 4 to 5 exhibit less provocative interaction and make more comforting-giving tactile contact with the dog (Millot and Filiatre, 1986). In any case, allowing the child to taunt, grab, pull, pinch, step on, chase, throw things at, hit, kick, stomp, or fall upon the dog is a sure way to increase irritability and reduce tolerance for close social contact with the child. Every normal dog has a breaking point that is sooner or later reached, and the child is finally punished for his or her lack of consideration and sensitivity.

Many problems can be avoided by making sure that the young child is allowed to interact with the dog only while an adult is present to supervise, at least until the child demonstrates an adequate ability to treat the dog with care and respect. During such periods of supervised interaction, the child's behavior is carefully monitored, with appropriate behavior being reinforced with affection and other suitable rewards, while inappropriate behavior is consistently discouraged. The child should be taught that interacting with the dog is a privilege based on good behavior. One strategy for promoting this learning involves giving the child merits for appropriate interaction and demerits for inappropriate behavior toward the dog. The accumulation of three demerits causes the child to lose the privilege of interacting with the dog for some set period. The child can avoid this consequence by working off demerits by earning merits based on appropriate behavior. In other words, demerits can be canceled by earning merits based on giving the dog appropriate care and respect. In addition, after earning three merits, the child may be given a token (e.g., a star) that he or she can save and exchange for various rewards or desirable activities.

Child-initiated Aggression and Sibling Rivalry

Within the context of family dynamics, emergent canine behavioral characteristics (individual differences) are differentiated and expressed, giving rise to an extraordinary variety of social behavior and coping styles. In large families, preferred affiliative relations may form that produce conflict and competition between children for a dog's attention. Some of these attachments and affiliations appear to promote distinctions resembling social rank. The dog may show favoritism toward certain family members and become progressively intolerant of interaction with others. Much of this organizing process is based on the quality of the exchanges and transactions between the dog and different family members. Transactions conducive to enhanced comfort and safety are preferred to transactions producing discomfort and threats. The obligatory subordinate status of dogs is dependent on leadership (see *Dominance, Social Distance and Polarity, and Begging for Love*), that is, structured interaction that results in enhanced comfort and safety (nurturance). In relation to other obligate household subordinates (dogs and children), the dog may form dominant-subordinate sibling relations. The nature of these sibling relations and dynamics may be in part due to competition for the same social resource, that is, the nurturance and security provided by the parent. As a result of combined needs that exceed the parent's ability or willingness to fulfill, a potential source of conflict between the dog and children may develop and result in sibling rivalry. This natural sibling tension may be intensified significantly in cases where the parent shows an evident preference toward the dog by the quality of attention and care given to it versus the child. The added attention given to the dog may inadvertantly establish a problematic alliance between the parent and the dog, perhaps activating species-typical agonistic scripts and competition between the dog and children.

Typically, dogs are enormously tolerant of child-initiated interactions, most often ignoring or reciprocating in kind (especially with regard to friendly and comfort-giving behav-

iors), or retreating in response to aversive or aggressive behaviors. Millot and colleagues (1988) found that the aggressive behavior initiated by a child toward a dog was most likely followed by retreating or avoiding behaviors. The most likely child behaviors to produce biting or attempts to bite were pulling the dog's tail, fur, or paws. Dogs were found to be surprisingly tolerant toward threatening, hitting, or object-throwing behavior. Interestingly, dogs exhibited no aggression toward children interfering with them while in possession of objects, but were most likely to give the object up or retreat. The researchers suggest that much of the child's aggressive behavior toward the dog *could be* of a redirected nature. Such child-initiated aggression toward the family dog may reflect a more general failure of the child to integrate friendly and cooperative social relations with peers and adults. Thus, the dog may represent to some children a relatively safe object for discharging frustration and passing on aggression received from other children or adults (see *Sources of Conflict and Tension Between Children and Dogs* in Volume 2, Chapter 6). Children suspected of showing such behavior need to learn how to cope more effectively with social stressors and how to redirect their aggressive impulses into more constructive outlets. A small percentage of children who are persistently provocative and cruel toward the family dog and other animals may be affected by disturbances impeding their ability to regulate emotion and aggressive impulses. Approximately 2% to 9% of children in the United States are affected by conduct disorder. Some authorities estimate that 25% of these children show cruelty toward animals and that animal abuse is often the earliest sign of the disorder (Miller, 2001). Inculcating a caring and humane attitude toward dogs and other animals should be a central part of childhood education and socialization.

Interspecific sibling rivalry and competition for parental attention and care may also represent a significant source of agonistic tension between children and dogs. How children respond to sharing the home and parental attention with the dog depends on a wide range of emotional, behavioral, and developmental variables. Children may show a highly ambivalent and conflictive attitude toward the dog. Young children often show inconsistent social interaction toward the dog, including elements of affection, intrusive interference, and exploitive mischief. In many cases, these behaviors appear to be calculated to obtain or to divert parental attention and resources away from the dog. For emotionally secure children, the dog may mediate a more mature and cooperative relationship with the parent and other siblings. Such children may take an active role in training and caring for the dog; that is, they help to parent it. Other children may show a variable lack of interest or an apparent aversion toward it (e.g., an inordinate disgust toward its saliva). Such children may form a relationship with the dog only to please the parent, but secretly hold the dog at a distance emotionally. Some children may be highly critical of the dog's habits and intelligence, refusing to form a relationship with it and rejecting efforts to help bridge the gap. Finally, a small minority of children may exhibit an overt and habitual pattern of insensitivity, cruelty, and stimulation-seeking activities that may include agitating or tormenting the dog.

Dogs shown preferential treatment by adults in the household may become increasingly confident and bold with respect to sibling subordinates. Instead of fleeing to avoid the interference of children, they may simply confront and threaten them fearlessly. Such dogs may show a high degree of social competence and purposefulness in the process of setting limits on the intrusive behavior of children. They may show a welcoming tolerance for interaction that is gentle and respectful, but rapidly respond to mishandling or uninvited intrusions by stiffening, growling, snarling, snapping, or biting the child to impress their point. Mishandling and interference with the dog while it is eating, resting, or chewing on toys may significantly decrease the dog's tolerance for contact and lower aggression thresholds. Clumsy and painful efforts to pick up the dog as a puppy may also play a prominent role in the development of preemptive threats and attacks to hugs and

grabbing movements. Such dogs may show little sign of anxiety or active aversion toward the child, but instead seem to use aggression in a proactive way to limit unwanted social behavior and rewarding appropriate behavior with affectionate tolerance.

The selectiveness, purposefulness, coolheaded, and limited nature of these confrontations and limit-setting actions is consistent with a social-training interpretation, insofar as social training is defined as a process whereby limit-setting actions serve to open a social space within which appropriate behavior is encouraged by reward. The adaptive and measured nature of such attacks warrants the term proactive aggression. In some cases, however, successful control of one family member with threats or force may lead to dynamic changes in a dog's interaction with other family members belonging to the subordinate-sibling group (see Chase et al., 2002). Other family members observing these educational transactions may exhibit an increased sensitivity and avoidance of exchanges that might agitate the dog, thereby learning from the demonstration and reinforcing the dog's trainer role. Smaller breeds expressing medium anger and high fear thresholds may be particularly prone to exercise social power of questionable competence by means of threats and inhibited bites directed against intrusive children. Although the danger of such behavior would naturally rise to an entirely different level of significance and concern in the case of larger dogs or dogs showing impulsive aggression, the diminutive aggressor may enjoy a special status and alliance with a parent, who may grant "training" privileges to the dog with respect to an unruly child. To prevent the escalation or transition of the "trainer" script into the despot script and interaction that poses a much greater risk to the child's safety, it is imperative that dogs and children learn from parents how to respectfully interact one another.

In addition to procedures used to organize the social engagement system (orienting, approaching, and attending) (see *Dominance, Social Distance and Polarity, and Begging for Love*), preliminary testing suggests that the model/rival method may be useful in certain cases to help integrate more friendly interaction (see *Rapid Complex Social Learning* in Chapter 10). By allowing dogs to observe highly formalized and friendly exchanges between a parent and child (model/rival dyad) with exchanges focused on an object of significant interest to the dog, some dogs appear to rapidly encode the general significance of the observed interaction and show immediate behavior remarkably consistent with it. While observing such brief social encounters, dogs may internalize the emotional significance of the interaction, appearing to prepare them to respond to the object and the model/rival demonstration in a script-consistent way. Dogs appear to be highly sensitive to the significance of social interaction between a social superior and inferior (rival) in the process of obtaining reward or punishment in the context of controlling a valued object. The full value of the method remains to be explored, but preliminary indicators suggest that the effect produced is robust and useful as an adjuvant procedure for priming emotional arousal and rapidly integrating social scripts. In addition to modeling affectionate behavior and cooperative behavior, the procedure may have usefulness for treating object-guarding problems and for helping to mediate the integration of more tolerant and friendly behavior toward visitors.

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8

Impulsive, Extrafamilial, and Intraspecific Aggression

PART 1: INTRAFAMILIAL AND EXTRAFAMILIAL AGGRESSION

The care and training received by dogs with aggression problems is frequently not much different from the treatment received by dogs that do not develop aggression problems. Why one dog is friendly and another dog aggressive when both grow up in the same household is only an enigma to the extent that one assumes that the needs of the two dogs are the same. This underappreciation of the diversity of canine individual differences and needs for individualized socialization and training has led to considerable confusion and mismanagement of dogs. The interactive and environmental needs of dogs vary considerably, not just between breeds, but also between individuals of the same breed. What for one dog may promote a secure attachment, for another may represent an intolerable situation facilitating ambivalent social and place attachments. The obvious implication with regard to the prevention and treatment of aggression problems is that dogs require socialization, training, and quality-of-life enhancements that are tailored to meet the dog's particular needs.

As argued in Chapter 7 and expanded upon below, the social dominance hypothesis does not appear to have much value for understanding and treating most intrafamilial and extrafamilial aggression problems. Several features of canine domestic aggression (CDA) conflict with the dominance hypothesis, including the incompetent and insecure nature of attacks; the antecedent activities and situational peculiarities leading up to attacks; the panicogenic, catastrophic, and paroxysmal nature of arousal associated with attacks; the reactive negativity bias shown toward ambiguous social signals given by persons intimately familiar to the dog; and the terrified appearance of aggressors at the flash point of attack. Diagnosing such behavior as dominance aggression seems akin to tossing a pig in the air and claiming that pigs can fly. Although dominance relations in the organization of dog behavior are not entirely trivial, especially as regards interdog relationships and the setting of social limits on undesirable behavior,

dominance as a proximal cause of reactive and impulsive aggression appears to be little more than a narrative account with little substantive value as a causal concept. The dominance diagnosis appears to be more relevant to how humans cope with dog bites and canine misbehavior in general than to the etiology and rational treatment of aggression problems.

Anthropic dominance ideation converts intrafamilial and extrafamilial CDA into a form that absolves the victim from responsibility while demonizing the canine aggressor with despotic social or territorial intent, thereby justifying abusive appetitive and emotional deprivation, stressful isolation tactics, and physical maltreatment in the name of canine behavior therapy aimed at changing the dog's dominant attitude (see Bugental et al., 1997 and 1999; also see *Anthropic Dominance Ideation, Perceived Power, and Control Styles* in Chapter 10). Far from the confident picture that one might expect from a dominant dog, many of these so-called dominance aggressors appear to be socially incompetent, insecure, and reactive in their dealings with people. In severe cases, just before attacking, impulsive aggressors appear to be overwhelmed by intense sympathetic arousal that seems foreign to the dog and inappropriate to the evoking stimulation. Although impulsive aggression has been linked to seizure activity (see *Epilepsy* in Volume 1, Chapter 3, and *Assessment and Identification* in Volume 2, Chapter 8), most authorities currently downplay the seizure hypothesis. Although limbic seizure and a host of other biogenetic and neurobiological factors (e.g., serotonergic/dopaminergic imbalance) appear to contribute in various ways to the expression of aggression, very little clinical or experimental evidence points to any single variable or set of variables as a cause of aggression.

Autoprotective aggression can occasionally be traced to specific abusive or traumatic experiences. In one such case, a woman with a psychotic condition obtained a puppy as a companion after her release from a state psychiatric hospital, where she had apparently resided for several years. According to reliable witnesses, the woman came outside at various times during the day to sit on the stoop and affectionately stroke the puppy and fuss over it with sweet talk. For unknown reasons, the woman periodically became enraged and would turn without warning and slap the puppy forcefully along the side of its head, whereupon she would appear to be very sorry for the action and attempt to comfort the puppy with petting and other expressions of affection and comfort giving. As the puppy calmed down, the woman would again, for no apparent reason, turn and forcefully hit the puppy, causing it to yelp in distress. This ritual was observed on several occasions and prompted neighbors to take action to rescue the puppy. It was adopted and raised successfully without notable adverse signs of the abuse from its experience until approaching adulthood, when it began to bite visitors in a very odd way. During greetings, the dog showed very friendly behavior and quickly warmed up to visitors and accepted their petting without any sign of resentment or fear. But suddenly, and without warning or provocation, the dog's demeanor would rapidly change from affection to rage and, in an instant, it delivered hard bites to hands as it was petted about the head. The aggression was limited to visitors with whom the dog had formed some degree of affectionate contact, and the attacks occurred only while the dog was being petted. The dog had an affectionate and nonaggressive relationship with a caring and protective owner. The bizarre attacks were otherwise inconsistent with the dog's temperament and by observation could not be guessed from any behavioral signs. The etiology of this bizarre and dangerous aggression appears to have stemmed from the abusive unpredictable and uncontrollable handling that the dog was exposed to as puppy, perhaps resulting in the formation of toxic expectancies in association with petting. While initially accepting the visitors' petting, as the interaction continued an apparent internal conflict emerged that rapidly escalated into a fearless panic-type attack. One is tempted to interpret the aggression exhibited by the dog in terms of a collision of affection, a toxic expectancy formed in puppyhood, and a sudden loss of safety and trust, resulting in the release of an angry hard bite. The owner

may have been protected from such attacks by having formed a trust-based bond with the dog reinforced by a history of safety in the context of affection (see *Contact Aversion and Aggression* in Volume 2, Chapter 8).

In addition to etiologies associated with abuse, aggression problems appear to be related to less obvious biogenetic and epigenetic causes (e.g., exposure to prenatal stress) that are incubated by social exchanges promoting a negative coping style. According to cynopraxic theory, neurobiological systems are malleable and adapt in response to both positive and negative adjustment pressures, making selective attention and behavior the axial conduit for the mediation of both disturbance and therapeutic change. The neural plasticity resulting from cynopraxic attention and behavior training serves to entrain compensatory neural and physiological changes in the process of integrating social skills, adaptive coping style, and secure attachments. These neurobiological changes are hypothesized to promote autonomic, cognitive, and emotional regulation conducive to enhanced attention, impulse control, and calming. More specifically, with respect CDA, cynopraxic therapy facilitates the acquisition of cognitive and behavioral skills incompatible with aggression by arranging conditioned and unconditioned stimuli, social exchanges, and environmental enhancements to promote autonomic attunement and affectionate play. As such, the executive attention and impulse-control deficits, emotional distress, and autonomic disturbances associated with a reactive coping style and aggression are interpreted as flowing from social interaction and home environments promoting ambivalent (nervous/insecure) attachments. The integration of secure social and place attachments via cynopraxic therapy promotes social trust and autoattunement, enabling dogs to form social bonds and to explore new social relations competently and novel environments under the regulatory control of enhanced sympathovagal balance.

CLASSIFYING AGGRESSION

In general, proactive control-related or instrumental (offensive and defensive) aggression is organized to achieve specific goals not otherwise achievable, showing the following characteristics: (1) a relatively consistent ensemble of sequential events and junctures (i.e., transitional points leading to escalation or de-escalation of hostility based on control-related outcomes) that move predictably from agonistic arousal, precursor intention movements, ritualized threats, and formalized interaction (e.g., exchanges and transactions) conducive to conflict resolution and subsequent reconciliation or, in the absence of alternative options, conclude with a moment of menacing suspense and overt confrontation/attack; (2) a demonstrated ability to escalate, de-escalate, or cancel agonistic processing at any juncture in the formal sequence of events; (3) a concordance or context appropriateness between the provoking situation, the trigger, and the magnitude of arousal and attack (i.e., severity and duration); (5) a functional significance [e.g., an offensive response to promote control interests (i.e., get-and-keep incentive) or a defensive response to aversive stimulation or an imminent threat of same (i.e., bite-or-die incentive) and responsiveness to outcomes (e.g., suppression by defeat); and (6) rarity (see Smith, 1977). Instrumental attacks may take a more confrontational and direct form (without much warning) in the context of social code violations (e.g., threatening to take a prized item and disturbing a sleeping dog), but such attacks (nips and snaps) remain inhibited and appropriate to the evoking situation.

In contrast, reactive or impulsive autoprotective aggression shows a lack of competent sequential organization, with antagonistic arousal rapidly transitioning into a default attack mode that is often severe, uninhibited, out of character, and disproportionate to the provoking social context. Impulsive attacks tend to increase in frequency and severity over time, suggesting a process of progressive disinhibition influencing the expression of such behavior. Twelve prominent independent variables appear to play important roles in the etiology of reactive/impulsive autoprotective aggression: (1) genetic predisposition; (2) developmental adversity (prenatal, perinatal, and postnatal stress and insults); (3) interac-

tive disturbances impairing executive attention and impulse control; (4) lack of competent social coping skills and play; (5) persistent interactive conflict; (6) social ambivalence (distrust and unfairness) in association with growing anxiety, irritability, and intolerance; (7) a history of mismanaged competition and proactive aggression; (8) a reactive trigger formed in association with loss or risk; (9) the presence of nervous/insecure social and place attachments; (10) loss of trust and autonomic attunement; (11) deprivational environmental conditions; and (12) entrapment.

An aggressive dog's appearance of aloofness, inattention to social signals, insular resistance to owner control efforts, reduced playfulness, and arbitrary threats and attacks are frequently viewed through the distorted and pseudoscientific image of the "alpha wolf" and other prominent ethological myths. According to cynopraxic theory, the social withdrawal and tuning out of an ambivalent attachment object is not indicative of dominance, but rather represents a gradual process of social and attentional disengagement in anticipation of reduced impulse control and increasing social repulsion and intolerance. Under the inescapable conditions of domestic life, dogs are compelled to cope and adjust to the social and environmental circumstances that they find, since leaving the situation is not a viable option. Domestic situations lacking sufficient fairness, order, and resources to meet basic canine social and biological needs pose special challenges. Dogs cope with adverse and inescapable household conditions in three principal ways, depending on perceived controllability and fairness: (1) Households and interaction perceived as being relatively uncontrollable and deprivational promote a reactive coping style and autonomic regulation conducive to nervous attachments. (2) Households and interaction perceived as being relatively controllable and providing for basic needs, but unfair and enabling or coercing dependency by means of indulgence and/or subjugation, tend to promote insecure attachments. (3) Households perceived as being relatively uncontrollable, deprivational, and unfair facilitate autonomic shifts and dysregulation, making the ambivalent attachment object a target for reactive or impulsive autoprotective aggression.

In addition to conditioned aversive associations stemming from interactive conflict, a major source of anxiety and anger is related to the motivated disengagement of attention and social resources from an ambivalent attachment object. As such, the *anxious anger* of social ambivalence is an amalgam of anxiety and anger fused under the escalating tensions of entrapment and autoprotective motivations evoked by interaction perceived as inconsistent, unfair, and inescapable. Social ambivalence and entrapment dynamics are hypothesized to promote reactive and impulsive behavior flowing from the gradual or precipitous disengagement of attentional and social resources in the process of degrading impulse control and autonomic/emotional regulation. Increased anxiety and reduced impulse control are the natural corollaries of diminished selective and sustained attention. The anxiety component of social ambivalence is hypothesized to infuse ambivalent exchanges with distrust, whereas the anger component of social ambivalence, flowing principally from the retraction of the social engagement system in response to anxious and unfair exchanges, generates social repulsion, irritability, and intolerance.

The net effect of social ambivalence and entrapment is to install a preemptive negativity bias consisting of distrust and intolerance, altering the way the dog perceives, interprets, and responds to exchanges with the ambivalent attachment object. Autoprotective or exploitative (antisocial) behavior shown in response to ambiguous actions and unexpected change reflect a negativity bias and autonomic misattunement, whereas prosocial behavior in response to ambiguous actions and unexpected change reflects a positivity bias and autonomic attunement. Whereas incompetent reactive or impulsive dogs may respond to ambiguous social exchanges as signifying a threat of loss or risk, dogs operating competently under the regulation of secure attachments tend to approach ambiguous situations confidently with an anticipation of fair exchange and reward.

Antipredatory Strategy and Autoprotection versus Dominance

Dogs that fail to attract, attach, and please human companions prove too expensive or inconvenient, or otherwise become undesirable or unwanted as pets are at risk of being relinquished, concentrated in shelters, and destroyed if no one takes an interest in forming an attachment with them. The millions of dogs killed every year is stark evidence of the human appetite for the pleasures of canine companionship and the default lethality awaiting dogs that fail to provide it. Among the Romans, unwanted infants were often left to die in a public place unless a passerby happened along to rescue them, a practice that frequently resulted in the children becoming slaves. The foregoing practice of infant exposure seems to roughly prefigure the modern-day function of the shelter whereby dogs that are no longer wanted are relinquished, put on public display, and subsequently killed if they fail to inspire sufficient attraction or pity to integrate an attachment. The act of relinquishment allows owners to seek a more gratifying pet while separating themselves from the unpleasantness of disposing of the unwanted one. The subsequent killing of the unwanted dog makes room for more dogs, thereby perpetuating the cycle of extracting affection and submission from the canine attachment object and destroying those that fail to provide it. The pattern of taking an infant puppy away from its biological family, subjugating it by force and restraint, abandoning or relinquishing it, and destroying the dog when it is no longer wanted represents a pattern of exploitation that infuses the human-dog relationship with an inherent paradox (Tuan, 1984; see *Yi-Fu Tuan* in Volume 1, Chapter 10). The predatory exploitation of the dog for its fur and flesh is sublimated and institutionalized into a less obvious predatory preoccupation with the exploitation of its capacity to provide affection, submission, and utility. As such, the dog is transformed into a prey object whose ability to gratify human needs depends on it staying healthy and alive, at least during times of plenty. These predatory pressures centering on the human appetite for affectionate companionship and dominion have selected for traits compatible with taming, social submission, and training, while simultaneously suppressing canine predatory propensities and behaviors.

As an object of human attachment and domination, a dog is spared from the knife and fork but not from cruelty and death if it fails to yield the social resources for which it is spared and upon which its protected status depends. Under these sorts of life-and-death pressures, it is reasonable to expect that dogs might have evolved various complementary antistress and antipredatory coping strategies to reduce the risk of human exploitative appetites and abuses. Dogs appear to have evolved an ability to integrate secure attachments that mediate autonomic regulatory changes in their human keepers. The dependency and insecure attachment produced by indulgence and domination is hypothesized to combine with affectionate submission and begging to facilitate parental-like care and protectiveness, the secure feelings of unconditional acceptance, and, potentially, the joy of affectionate play. These emotional and behavioral effects of autonomic attunement may help to ensure that keepers will not decide to abuse, eat, abandon, or kill their dogs. The dog's neotenous appearance, soft fur and appreciation of petting, and the giving of unconditional acceptance to the keeper may be important positive antipredatory adaptations that further enhance attachment-mediated autonomic control. However, in response to ambivalent attachments and entrapment, negative antipredatory survival modes may be activated in the process of lowering autoprotective flight-fight thresholds. Historically, at times of dearth, dogs may have lost their protected status, just as today dogs are at an increased risk of relinquishment and death if they become inconvenient or too costly to maintain. As a result, indicators of reduced parental investment (social attention and care) and resource availability appear to activate additional antipredatory survival modes that increase avoidance and dispersive tensions. The dog's apparent sensitivity to social and environmental quality-of-life changes, as indexed by changes of affiliative receptivity,

dispersive tensions, and altered flight-fight thresholds, is consistent with the activation of encoded survival modes responsive to changes likely to anticipate a change in predatory risk.

Despite the evolution of a specialized antistress system for coping with ambiguous, novel, and unexpected events, dogs appear to be especially vulnerable to show reactive behavior at times when selective attention is disengaged. For example, disturbing a dog while it is asleep has been associated with fierce attacks that have confirmed the wisdom of the proverb "Let sleeping dogs lie" countless times (see *Aggression Associated with Disturbances While Resting* in Chapter 7). The dog's love of sleeping in close company with humans, especially on the bed, and the immense enjoyment that many people derive from sleeping in close quarters with a dog may point to an important adaptation having ancient origins, perhaps helping to keep many dogs out of the communal pot. Sleeping with dogs may have provided ancient dog keepers with feelings of enhanced security and comfort (see *The Dingo: A Prototypical Dog* in Volume 1, Chapter 1). These comfort-enhancing benefits may have been especially important resources for the young, sick, frail, or elderly, perhaps providing an interesting account for the evolution of traits conducive to a natural sense of compassion and gentleness. Instead of preying on the weakness of such people, dogs often show them special treatment—behavior that is commonly extended to young children, as well. During the dog's evolution, it has shed most of its predatory instincts, in the process acquiring traits conducive to forming a symbiotic mutualism with human guardians. Essentially, the domesticating process has transformed the canine predator into a predatory object dependent on the subjugating predator for care and protection. Within the context of these evolutionary developments and trends, the notion that dogs might have evolved a set of complementary or antithetical antisocial and antipredatory tactics to cope with the uncertainties and risks associated with living with a predator represents a plausible hypothesis. The reactive and impulsive nature of CDA seems to have far more in common with an antipredatory coping strategy (Kavaliers and Choleris, 2001) than it shares with the idea that dogs attack people to enhance their social status or defend their territory, something that they may do with conspecifics but not with human subjugators. Just as a prey animal may seek to avoid predators by reducing activity and limiting the time it spends in open spaces, the autoprotective orientation shown by many dogs may stem from an analogous antipredatory strategy activated in the context of home situations perceived as unsafe and unsatisfying.

Dogs appear to survive under domestic conditions by means of forming attachments facilitated by affectionate play. According to this hypothesis, affectionate play transactions integrate an autonomic attunement in humans that is conducive to a state favorable to alloprotection and caregiving, perhaps offsetting human predatory interests and power-dominance motivations toward the canine attachment object. The autonomic attunement associated with reciprocal affectionate play exchanges between the dog and human predator promotes social trust and bonding in support of the continuation of affectionate playfulness and the integration of harmonious social relations and mutual appreciation. In addition to secure attachments and the autonomic attunement facilitated by affectionate play, the human-dog bond appears to depend on predictable and controllable exchanges giving mutual advantage via enhanced comfort and safety (security). Canine social trust appears to depend on a fair balance of advantages given and advantages taken in the process of obtaining comfort and safety. An appreciation of fairness appears to emerge in the context of play, since, in the absence of parity, play stops or becomes increasingly exploitative and cruel. Affection is motivationally incompatible with cruelty and, in combination with play, promotes fairness and harmony in human-dog relations. Insecure attachments based on relatively consistent but unfair interaction promote social dynamics conducive to a loss of trust and increased reactivity toward ambiguous social exchanges and unexpected change. Social exchanges that give excessive advantages to the dog, or unfairly force the dog to yield advantages to

the human controller, mobilize disruptive social dynamics that impair affectionate play and bonding. For example, dogs that unfairly receive advantages by indulgent treatment may become increasing dependent and form an expectancy of interaction that is narrowly focused on receiving rather than yielding advantages. In contrast, dogs from which unfair advantages are taken may become increasingly unwilling to yield to exploitative control efforts. In both cases, the dog's ability to trust is reduced, along with social attraction and its ability to play, thereby setting the stage for social repulsion, irritability, and contact intolerance, and activating antipredatory coping strategies and autoprotective behavior in response to human exchanges perceived as posing a predatory threat. In contrast to the playful and cooperative response to human control efforts by dogs expressing secure attachments, dogs expressing insecure attachments show increasing rigidity in response to human control efforts. Similarly, nervous attachments formed in association with exploitative play and inconsistent and manipulative exchanges that evoke anxiety (lack of security) and anger (lack of attraction) keep the social engagement system off-line while mobilizing a variety of antipredatory autoprotective behaviors in response to human control efforts.

The intolerance for physical handling, restraint, and interference that reactive and impulsive aggressors show is consistent with an antipredatory function. These dogs may show tolerance for close proximity and petting but deliver severe and uninhibited bites if picked up. Many dogs reach the flash point of no return only after struggling unsuccessfully to break free from restraint or coping with abusive punishment. Under the influence of inescapable social anxiety and irritability stemming from interactive conflict and ambivalence, the home or areas within it may become more generally associated with entrapment and frustrated dispersive tensions evoking highly motivated autoprotective behavior toward family members. Reactive dogs frequently show aggressive behavior in response to unwelcome grooming, under the influence of an obvious autoprotective incentive. Such dogs may snap if their paws are touched, and become particularly reactive and dangerous if the owner attempts to trim the nails. Again, consistent with the antipredatory hypothesis, some dogs will bite only if grabbed or reached for after fleeing to cover behind a sofa, inside a crate, or under a bed or table, appearing to attack after an intensification of aggressive arousal triggered by entrapment and autoprotective panic. The relative amount of reactive arousal shown by dogs toward ambiguous or threatening social stimuli under such circumstances appears to index social attraction and trust rather than social status or a perception of rank.

Ambiguous activities, such as abruptly crouching down and kissing or caressing a sleeping dog around its muzzle, may stimulate sensations interpreted by the dog as an attack. Attacks at such times are often severe and damaging, followed by pronounced signs of emotional distress consistent with remorse. Dogs may be particularly vulnerable to such attacks when falling asleep (hypnagogic) or awaking (hypnopompic). The vibrissae provide autoprotective sensory information relevant to the detection of objects coming in contact with the face. For example, brushing the canine vibrissae evokes nonhabituating defensive blinking. Also, when making an angry pucker, the vibrissae are turned out and forward. These reflexive effects suggest the possibility that vibrissal stimulation around the face may trigger autoprotective sensations or threatening hallucinations (preemptive processing) when other sensory and attentional resources are off-line. Dogs dream, and these dreams often have sequences that involve apparent efforts to run away or attack an adversary. When startled from sleep, the imaginal content of these dreams may continue during hypnopompic transitions while a dog is awakening. The nature of dream images and their emotional significance may distort how the dog perceives and interprets the owner's actions. Further, during hypnagogic transitions between wakefulness and sleep, dogs may be vulnerable to disinhibited attacks in association with reduced attentional resources and impulse control.

Among human subjects, vague feelings of someone in the room or hallucinations of being attacked or experiencing terror (e.g., falling into an abyss or being caught in a fire) while transitioning in or out of sleep have been reported (Ohayon, 2000). In an urban population, violence in association with sleep and hypnagogic and hypnopompic hallucinations were found to be more prevalent among persons diagnosed with post-traumatic stress disorder (PTSD) than subjects not diagnosed with PTSD (Ohayon and Shapiro, 2000). Consequently, the possibility of a history of abuse or trauma should be evaluated in dogs exhibiting reactive explosive behavior when disturbed while sleeping or resting (hypnagogic). Reactive behavior in response to minimal provocation may be associated with the hair-trigger activation of dysregulated sympathetic circuits. The signal triggering the event may be arrhythmias or the abrupt withdrawal of vagal tone (e.g., when the dog is disturbed while resting) and the provocation of a potent sympathetic surge (see *Autonomic Arousal, Heart Rate, and Aggression* in Chapter 6). Such sudden surges of arousal may induce widespread disinhibition. Ascending signals may kindle stress-sensitized amygdalar or hippocampal circuits, perhaps resulting in reactive attacks (Pontius and LeMay, 2003). The canine amygdala is highly sensitive to kindling effects, resulting in pronounced cardiovascular changes as well as neck and jaw movements (Thompson and Galosy, 1983). In many of these cases, dogs also show autoprotective behavior in response to interference while in havens of comfort and safety while fully awake. Autoprotective behavior at such times may only rise to the level of crankiness and low-grade threats; in other cases, however, it might rapidly transition into a strong threat or attack. These variations in magnitude and severity suggest that trait anger may contribute to an increased propensity for such reactive behavior. A possibility exists that autoprotective aggression in association with sleeping and resting areas may stem from reactive arousal originally evoked in association with being awakened and then subsequently contextualized to the situation and associatively linked to the person. This could help to account for some cases involving inappropriate and explosive aggression near resting places in response to minimal provocation. It is interesting to speculate that during periods of increased social and environmental stress the dog's sleep may be agitated and susceptible to reactive adjustments in response to being awakened. The aversive emotional arousal and reactive behavior evoked at such times might facilitate conditioned social and place associations that may increase the dog's reactivity in the future when disturbed while in such resting places. The liability to develop this behavior may be especially problematic for dogs that have not had time to form competing expectancies incompatible with aggression. These observations may have relevance for understanding the odd finding reported by Guy and colleagues that suggests that puppies allowed to sleep on beds during the first 2 months had an increased risk of developing an aggression problem. In addition, given the disruptive influence of rehoming on previously established attachments and autonomic attunement, puppies may be vulnerable to integrate insecure attachments when allowed to sleep in the bed during the first few weeks.

Whether autoprotection takes a defensive or offensive (confrontational) form is determined by the presence or absence of anxiety/fear (defensive) and anger/frustration (offensive) (see *Species-typical Defensive and Offensive Aggression* in Chapter 7). According to the antipredatory hypothesis, the defensive form of autoprotective aggression is shown reactively toward familiar and unfamiliar targets in response to interaction perceived as posing an inescapable threat. In contrast, the offensive form of autoprotective aggression is impulsively directed toward familiar targets perceived as posing an unappeasable or uncontrollable challenge. Whereas autoprotective defensive arousal is activated by the uncertainty evoked by social novelty or unexpected change, familiar persons and household members with whom the dog has formed nervous attachments via interaction lacking consistency may evoke conditioned autoprotective arousal in conjunction with the disengagement of attention (anxiety), dispersive tensions, and entrapment. In the

absence of attachment relations, vigilance may represent a tactic used by reactive dogs to regulate autonomic tone to establish a state of readiness while simultaneously postponing action. In the case of nervous attachment objects, the withdrawal of attention by the reactive dog is hypothesized to occur primarily as the result of a perceived lack of predictability or relevance informing the object's exchanges. Attentional disengagement from a nervous attachment object is believed to increase social anxiety and decrease impulse control via the withdrawal of parasympathetic tone. Autoprotective offensive behavior, on the other hand, appears to develop in association with insecure attachments or secure attachments that have been disconfirmed and disrupted by a loss of trust and the autonomic dysregulation resulting from social disengagement (anger), motivated inattentiveness (anxiety), social ambivalence, and entrapment. Whereas autoprotective defensive behavior is primarily dedicated to reactive coping with risk, autoprotective offensive behavior is primarily dedicated to impulsive coping with loss. Finally, autoprotective panic—a catastrophic or explosive state of aggressive arousal—is triggered by social interaction simultaneously evoking both loss (anger) and risk (anxiety) occurring in the context of reactive adjustments to social challenges or threats.

Entrapment appears to switch the dog motivationally from a flight mode to an autoprotective fight mode. Punishing the dog beyond the first sign of appeasement, or pursuing it into safe refuges and denying it the ability to obtain comfort and safety (entrapment), represent critical interactive changes that escalate autonomic and emotional arousal and cause the dog to shift the motivational direction of autoprotective behavior away from flight to turn and confront the threat with aggression. The autonomic and emotional regulation and arousal profile concurrent with the relaxation phase of escape to safety appears to be qualitatively similar to the autonomic and emotion arousal evoked by safe havens (e.g., resting on a sofa or bed). Safe refuges and havens (secure place attachments) evoke autonomic relaxation and feelings of enhanced security (comfort and safety). The antipredator hypothesis of canine domestic aggression postulates that the primary causes of aggression are related to social triggers that threaten (defensive) or challenge (offensive) the dog's ability to optimize survival security (comfort + safety) and well-being by (1) thwarting the dog's ability to escape to safety when threatened with danger, (2) interrupting the relief or relaxation phase of safety by invading the safe refuge, (3) intrusion or forcible theft of a valued comfort activity or object, (4) interruption of a survival activity conducive to comfort (e.g., eating or sleeping) (5) conditioned stimuli acquired in association with items 1 to 4 and the integration of ambivalent (nervous/insecure) social and place attachments, and (6) acquired triggers that activate autonomic preparatory arousal and sympathetic tensions conducive to the activation of the antipredator mode. Whether a dog adopts a defensive or offensive tactic depends on the incentive operating at the moment of arousal (fear or anger) and history of consequences resulting from past autoprotective actions (see *Species-typical Defensive and Offensive Aggression* in Chapter 7).

The ability to sneak off with food objects left unattended or discarded may have been an important source of nutrition in the dog's evolutionary past. With the loss of predatory modal behavior, dogs may have integrated scavenging and pilfering survival skills to enhance their ability to survive as they became increasingly dependent on human resources for survival. Dogs that succeeded in getting away with such pilfery probably enjoyed a higher likelihood of survival, but stealing food may have exacted a heavy penalty if the dog was caught in the act, perhaps exerting selection pressures that gradually encoded relevant sensory, cognitive, and emotional propensities improving the dog's ability to interpret and anticipate human deictic (pointing) signals and threats (e.g., finger and gaze directional commands) and attentional states (see *Deictic Signals and Directional Cues* in Chapter 10). These survival skills may have included defensive strategies to evade capture or to escape, if caught

(nip), perhaps learned in the context of certain play activities. Many of these enhanced adaptations and phylogenetic survival skills appear to be patched into canine play via augmented capacities for forming complex social attachments and coping with social ambiguity and uncertainty—critical paedomorphic changes that shadow decreasing predatory self-sufficiency and reduced fear of humans in the process of promoting a lifelong dependency on humans. These paedomorphic changes enhancing the dog's ability to form affectionate and playful relationships enable the dog to integrate the phylogenetic survival skills and coping abilities needed to adjust to domestic life.

Taking a forbidden item, evading capture, and then escaping to a safe refuge with the prize are part of a highly prepared sequential pattern that is rapidly learned by dogs. Mishandling of such exchanges may integrate problematic autoprotective dynamics, perhaps facilitating overt antipredator defenses in adulthood toward family members. For example, punishing a dog after forcing it out of a safe refuge, grabbing a leg or tail and dragging the dog into the open, chasing and cornering it with the help of other family members (particularly boisterous children), or prying objects out of the dog's mouth appear to be correlated with adult aggression problems. Similarly, punitive handling associated with safe havens, such as repeatedly grabbing a dog by its collar or scruff and pulling or throwing it off furniture, may promote increased vigilance and readiness to bite when approached under similar circumstances, especially in cases where reactive exchanges are a prominent part of a general pattern of daily conflictive interaction and ineffectual discipline. Most canine reactive behavior is the mirror reflection of incompetent human control efforts. The antipredatory mode appears to mobilize stress-sensitized flight-fight-freeze networks formed in association with inescapable interactive conflict. Reactive autoprotective behavior is distinguished by the presence of a preemptive negativity bias and automatic adjustments in response to ambiguous or ambivalent social stimuli. In contrast, proactive interaction and training activities integrate a positive preemptive social orientation and bias toward social uncertainty via structured exchanges conducive to an adaptive coping style. In addition to the mutual autonomic attunement and balance mediated by structured training, cynopraxic procedures serve to activate flirt-play, forbear-nip, and forgive-reconcile antistress and antiaggression systems (see *Phylogenesis, Polymorphism, and Coping Styles* in Chapter 6)—changes conducive to an enhanced capacity to cope with ambiguity, ambivalence, and novelty. Affection and playfulness are the reflection of preemptive emotional and behavioral biases that govern an adaptive coping style organized in association with the integration of secure social and place attachments and a trusting bond—changes incompatible with the dispersive tensions and dynamics that coalesce in the expression of impulsive or reactive autoprotective attacks.

The binding of attentional functions to chronic social ambivalence and entrapment dynamics diverts adaptive resources away from social engagement, cooperation, and reward-seeking activities. This shift of attentional focus is not only correlated with aggression but is hypothesized to represent a significant proximate factor mobilizing the autonomic misattunement and emotional distress conducive to ambivalent attachments, a reactive coping style, and the activation of an antipredatory mode of social interaction. The notion of an autoprotective phenotype activated in response to social conflict and entrapment appears to offer a far more useful way for studying the motivational and social etiology of aggression problems than does the social dominance narrative. According to cynopraxic theory, the interaction between friendly familiars consists of transactions that evoke feelings of comfort and safety and mutual autonomic attunement while promoting secure attachments. The refinement of social adjustments and changes conducive to mutual autonomic attunement and secure attachments is mediated by an adaptive coping style emerging in association with autoinitiated control incentives, prediction-control expectancies, and calibrated emotional establishing operations in the context of mutually

beneficial cooperative exchanges and fair-play compromise. In contrast, social interaction lacking sufficient consistency to promote an adaptive coping style and secure attachments promotes nervous attachments, dispersive tensions, and autoprotective behavior arising in association with social ambivalence (apprehension and resentment) in response to inescapable coercion, exploitation, and domination. Under the influence of coercion and inconsistency, social behavior becomes increasingly alloinitiated, dependent, and reactive. Dogs showing a reactive coping style may lack the ability to competently autoinitiate behavior based on proactive control incentives. In addition, such dogs appear to lack the requisite autonomic and emotional regulation needed to integrate and refine secure social and place attachments. According to cynopraxic training theory, the autonomy of interactive exchanges is a critical factor mediating adaptive social behavior and secure attachments. Social interaction lacking sufficient order (predictability and controllability) and variety to support autoinitiated behavior and an adaptive coping style will exert an intrinsically disorganizing influence on attachment behavior via social ambivalence, dispersive tensions, autonomic misattunement, and the integration of a reactive coping style. These observations emphasize that freedom and choice are critical aspects of social interaction conducive to the integration of an adaptive coping style and behavior incompatible with autoprotective behavior.

The motivated diversion of attentional and social resources away from the proactive processing of social exchanges appears to figure prominently in the etiology of reactive and impulsive social behavior and the activation of a antipredatory mode. Whereas attentional disengagement results in increased social anxiety and decreased selective attention and impulse control, social disengagement results in repulsion (irritability and intolerance) and withdrawal of the autonomic attunement that mediates attachment behavior. With the retraction of attentional and social engagement, family members may become increasingly alien and threatening (estrangement) to dogs. As a result of these autonomic, cognitive, and emotional changes, antipredator strategies become increasingly reactive, taking an active (flight-fight) or passive (freeze-helplessness) motivational direction, depending on the dog's temperament and the relative predominance of state versus trait anger and anxiety. The associated behavioral inhibition, withdrawal, and reactive irritability shown by such dogs may profoundly impair their ability to engage in competent social behavior. Such dogs may meet unwelcome approach and proximity with autoprotective conflict or attack. In other cases, perhaps where severe punishment has been used to suppress threat autoprotective threats, the dog may simply withdraw inwardly, becoming rigid and unresponsive to human contact. In contrast to nervous attachments, which reflect insufficient autonomic and emotional regulation to support impulse control and an adaptive coping style, insecure social attachments develop in association with an excessive and exclusive dependency on particular persons and places for autonomic and emotional regulation. Under the influence of social ambivalence and entrapment, insecure attachments may be focused on specific persons (e.g., adult parent) and places within the home (e.g., crate, sofa, or bed). Family members not included may be treated as threats insofar as their interference disturbs the comfort and safety obtained by the dog from being in close contact with the preferred attachment object or place. The loss of trust (disconfirmation of a safety expectancy) and the gradual or rapid withdrawal of attentional and social resources from an insecure attachment object may generate an increasing vulnerability for panicogenic arousal and explosive behavior in response to ambiguous interaction or handling perceived as threatening. For example, punitive efforts aimed at suppressing low-grade threats and growls shown by such dogs—displays that essentially signify inhibition and uneasiness about launching into an attack—may disrupt the dog's ability to process (inhibit and disinhibit) threat displays sequentially. In response to such mismanagement, the dog might learn to block low-grade threats by internalizing attentional resources and by coping passively until a flash point of

no return might be reached and an inappropriate attack is released under the exigency of blind panic.

In addition to the effects of social and attentional disengagement on a heightened risk of impulsivity, overly vigilant and apprehensive dogs may show cognitive deficiencies that impair their ability to shift attention selectively and to adjust emotional arousal in a phase-flexible way in response to ambiguous or novel social stimuli. Ambiguous signals may pose particularly onerous interpretive challenges for such dogs. Dog owners showing power-dominance conflicts and uncertainty about their ability to control social exchanges perceived as challenging their authority or showing signs of incipient household aggression may probe the dog with intentional and unintentional ambiguous signals to test its propensities, but in so doing only further agitate the dog and aggravate the problem. Low-grade reactive threats or growling prompted by ambiguous probes may cause the owner to punish the dog and thereby confirm the threat significance of ambiguous signals and increase the dog's reactivity and potential for releasing forceful autoprotective attacks toward similar social signals in the future. The repeated evocation and punishment of low-grade threats may systematically reduce the social trust (benefit of doubt) that normally inhibits reactive adjustments to ambiguous signals, causing the dog to become increasingly autoprotective and reactive when in doubt about the significance of social exchanges.

Ontogeny and Reactive Behavior

The process of autonomic attunement and behavioral integration appears to emerge early in life and is strongly influenced by a puppy's experiences prior to entering the home.

Antistress Neurobiology, Maternal Care, and Coping Style

Maternal care exerts several prominent effects on an offspring's ability to cope with social and environmental stressors in adulthood. These behavioral effects are reflected in numerous neurobiological changes that facilitate antistress capacities. For example, maternal responsiveness, nursing position, grooming, and licking behavior are closely tied to the density of oxytocin receptors expressed in brain areas mediating social and maternal behavior (e.g., the lateral septum and medial preoptic area). Rodent mothers providing high levels of grooming and licking also show significantly higher oxytocin-receptor densities in areas of the brain that mediate alarm and reactive behavior (e.g., the central nucleus of the amygdala and the bed nucleus of the stria terminalis) (Champagne et al., 2001). Most interestingly, however, is the finding that the mother's pattern of grooming and licking appears to stimulate the expression of a similar pattern of oxytocin-receptor densities in her daughters, thereby programming a maternal style resembling her own. In addition to being better mothers, the offspring of competent mothers are significantly less fearful of novelty than are offspring cared for by mothers that provide less grooming and licking care (Caldji et al., 1998). These less reactive offspring show increased gamma-aminobutyric acid/benzodiazepine (GABA/BZ)-receptor densities in the lateral, basolateral, and central nuclei of the amygdala. In addition, offspring receiving quality maternal care show decreased corticotropin-releasing factor (CRF)-receptor expression in the locus coeruleus together with increased α_2-adrenoceptor densities, changes consistent with reduced emotional reactivity.

Mothers may also transmit antistress effects to their young via lactation. Offspring of mothers given water tainted with corticosterone show a significant reduction in serotonin (5-hydroxytryptamine or 5-HT) subtype 1A receptors in the hippocampus (Meerlo et al., 2001). The offspring appeared to cope with stressors in a more passive manner than did controls, a change that reflected reduced reactivity rather than inhibition due to anxiety. Although chronic exposure to excessive corticosterone is harmful, moderate levels of the hormone ingested during lactation appear to produce beneficial effects on an offspring's ability to cope with stress in adult-

hood. Affected animals show improved learning abilities, reduced fearfulness, and a higher density of glucocorticoid receptors in the hippocampus—a change consistent with enhanced hypothalamic-pituitary-adrenal (HPA)-system regulation (Catalani et al., 2000). These various findings support the hypothesis that maternal care may *program* emotional and behavioral responses to environmental and psychological stressors that alter an offspring's coping style, perhaps by modifying thresholds controlling the activation of the flight-fight system.

The distribution of 5-HT and glucocorticoid receptors traced out during infancy appears to play a profound role in determining a dog's relative ability to cope with social stressors in adulthood. Postnatal handling has been shown to reduce significantly the density of 5-HT_2 receptors expressed in the frontal cortex and the hippocampus of adult animals, while 5-HT turnover and the density of glucocorticoid receptors in the amygdala and hypothalamus are left unaffected (Smythe et al., 1994). The reduced expression of frontal 5-HT_2 receptors may have relevance with regard to the etiology of impulsive aggression in dogs. Recent neuroimaging studies performed by Peremans and colleagues (2003) have found that dogs showing impulsive aggression exhibit increased 5-HT_{2A} receptor-binding potential localized in frontal cortical areas in comparison to nonaggressive dogs. They found no difference in the binding potential of 5-HT_{2A} receptors expressed in subcortical areas between aggressive and nonaggressive dogs (see *Stress, 5-HT_{2A} Receptor Upregulation, and Aggression* in Chapter 10). Also of interest are findings showing a close relationship between 5-HT and thyroid activity and infant stimulation. Meaney and colleagues (1987) showed that the distribution of 5-HT receptors fostered by neonatal handling depends on the activation of the pituitary-thyroid system and the release of triiodothyronine (T3). T3 stimulates the raphe bodies to release 5-HT into the ascending serotonergic system. 5-HT networks appear to guide the expression of cortical and hippocampal glucocorticoid receptors (Meaney et al., 2000). The early functional relationship between thyroid and 5-HT in organizing the stress-management system underscores the important role that 5-HT plays in mediating allostasis. The close linkage between 5-HT and thyroid in the organization of stress circuits gives some credence to the combined use of serotonergic antidepressants with low-dose thyroid in the treatment of certain aggression problems (see *Stress, Thyroid Deficiency, Hypocortisolism, and Aggression*).

Parent-Offspring Conflict and Interactive Conflict

Trivers (1972) proposed that an inherent conflict between parents and offspring revolves around the giving and receiving of care and nurturance. The theory postulates that mothers are selected to provide enough care to ensure the survival of their young but without impairing their ability to reproduce and care for more offspring in the future, striking a balance referred to as *parental investment* (PI). In contrast, the offspring appear to be governed by an exploitative incentive to inveigle the mother into giving more care than she can provide without endangering her ability to produce and care for more young. The parent-offspring conflict is hypothesized to exert a potent and dynamic influence on the development of social behavior, prompting a variety of psychological and behavioral strategies for manipulating the mother into giving more care than her PI allows:

> How is the offspring to compete effectively with its parent? An offspring cannot fling its mother to the ground at will and nurse. Throughout the period of parental investment the offspring competes at a disadvantage. The offspring is smaller and less experienced than its parent, and its parent controls the resources at issue. Given this competitive disadvantage the offspring is expected to employ psychological rather than physical tactics … It should attempt to induce more investment than the parent wishes to give. (Trivers, 1974:257)

The striving to induce the mother to give more care then her PI permits may be organized into analogous efforts to obtain from nature and others more than they are willing or able to give, as well. In fact, the dynamic

related to the parent-offspring conflict may be embedded in many motivational processes driving the optimization of control over significant social and environmental events and resources. According to this hypothesis, the core active incentives—exploitation and power—governing purposive behavior are balanced and tempered by submissive ritualization that may originate in the appeasement and begging strategies shown toward the mother to squeeze more attention and care from her. These core incentives may be further tamed in the context of play with siblings and the acquisition of social codes based on fair play. Perhaps, even what the dog values as a reward and abhors as punishment can be traced to the mother's contingent provisioning or withholding of nurturance (e.g., social proximity, tactile stimulation, and appetitive gratification).

The manner in which the mother copes with the conflict and manages the manipulative efforts of her offspring to exploit her may exert a lasting effect on the way the puppy copes with limits and social conflict situations in adulthood. The hypothesis being posited here is that the conflictive dynamics between the puppy and mother may contribute to the mobilization of either an adaptive or a reactive coping style, depending on how the mother responds to the puppy's care-seeking behavior. Accordingly, strategies developed to cope with the threat of maternal punishment and the delay or denial of anticipated care (frustration) may anticipate the organization of passive modal strategies (e.g., hesitating and delaying). In addition, the dynamic balance of activity success and failure associated with parent-offspring conflict may play a prominent role in regulation of autonomic tone mediating the organization of secure, nervous, and insecure social and place attachments. The relative balance of success versus failure in a puppy's efforts to attain comfort and safety or to exploit the mother might impact significantly on how well the puppy copes with anxiety and frustration associated with interactive conflict within the home, potentially exerting a profound influence on the organization of impulsive and reactive behavior. Mothers that are excessively responsive or unresponsive, punitive, or unpredictable in response to their offspring's care-seeking behavior may produce lasting developmental changes in canine personality development and capacity to integrate an adaptive coping style and concept of fairness. The good mother sets limits and manages conflict with her young in a constructive way, fostering a flirt-and-forbear/forgive (reconcile) orientation toward social conflict. Cognitive and emotional processing associated with parent-offspring conflict may contribute significantly to social engagement and shape tendencies toward a fair, exploitative, despotic, or an avoidant orientation toward others. Ideally, the transition from nursing and an exploitative dependency on the mother to a relationship based on affectionate submission, respect for limit, and ability to compromise sets the stage for the integration of harmonious relations in the home.

Maternal Mistreatment

Canine mothers exhibit significant variability in the way they cope with puppy care-seeking excesses. How the mother responds to demands for care depends on a huge array of variables, including allostatic load, available nutrition, the size of the litter, maternal experience, quality of maternal instincts, individual differences expressed in the behavior of the offspring, and the way the mother was cared for by her own mother. In addition to regurgitating for the puppies and providing them with solid food, the mother may cope with offspring care seeking by evading or shortening nursing or by leaving her young alone for longer periods. The mother may also assume ownership of the activity and set limits on it by means of a variety of overt tactics, including punishment. Highly competent canine mothers appear to make a deliberate effort to calm tensions and reduce conflict by means of gentle and slow movements. Rather than punishing her young, such mothers may block, nudge, or delicately muzzle her offspring to discourage unwelcome nursing while encouraging compromise. The mother appears to persuade her young to comply with a mild and affectionate approach rather

than resorting to intimidation and coercion, but the most patient and competent mother is not above applying a sharp rebuke against an overly obtrusive offspring.

In contrast to the competent maternal behavior just described, Rheingold (1963) found that canine mothers showed a wide spectrum of species-typical agonistic behavior toward their offspring (e.g., growling; barking; baring teeth; inhibited biting around the head, neck, or muzzle; brief shaking; or using a paw to hold the puppy down or pouncing at it) to which the puppies reciprocated various passive-submission displays (e.g., yelping, backing, lowering and submitting, rolling over, or scampering away). Of the five mothers and litters studied, two mothers habitually punished their offspring: a brown sheltie and a cocker spaniel. These mothers were observed continuously from shortly after birth of the litters to week 9. From the period immediately preceding the onset of weaning and extending to week 9, maternal agonism was frequent and severe in these mothers. A beagle and a black sheltie were never observed to punish their offspring, perhaps only because observations of those dogs were stopped at days 29 and 19, respectively. A merle sheltie was observed to begin punishing her puppies shortly before being removed from the study at day 42, a time coinciding with the peak of punishing activities exhibited by the brown sheltie and the cocker. The brown sheltie was often found in the whelping box from which vantage she would threaten her puppies if they attempted to enter. The cocker made normal life impossible for her offspring, attacking them whenever they attempted to eat from wet mash pans, when they approached her, or even when facing in her direction while she ate. Both the brown sheltie and cocker spaniel were observed to punish their puppies several times during most of the 15-minute observation periods. In addition to being frequent and severe, the punishment was delivered on an inconsistent basis, perhaps inoculating their offspring with an emotionally reactive orientation to social limitations, a tendency toward forming nervous or insecure attachments, and a reactive autonomic tone and HPA-system response to stress. Despite the harsh treatment received by the puppies, they continued to approach their intolerant mothers throughout the duration of the study:

> The pups persisted in trying to nurse, to make contact and to play with the mother. A cocker pup might flee from the mother's punishment, yelping and dragging its rear as though in pain, then, shortly, return to the activity. On the last day of observation [day 66], pups were still being punished upon approaching the mother, but they no longer tried to suckle.
>
> The pups' persistence should be weighed against the inconsistency of punishment, for the same act would be followed with punishment one moment but not the next. At times mothers seemed distracted by outside noises; at times they dozed. Then, especially, the brown Sheltie pups would try to enter the whelping box from the side or in back of the mother. Sometimes individual pups were indulged; the brown Sheltie, for example, occasionally permitted the runt of the litter to sleep in the box with her while the other pups were kept outside. (Rheingold, 1963:188)

Adverse stressors and insults taking place during exposure to an inconsistent, intolerant, and inimical mother, as in the case of these mothers, would likely install autonomic changes conducive to a coping style similar to her own and inoculate them with a tendency to form nervous or insecure attachments. Relevantly, Rheingold described the play behavior of these puppies as a "low frequency" activity. Play appears to serve a significant role in integrating secure social and place attachments and promoting autonomic balance (calm). Calcagnetti and Schechter (1992) found that rats given access to a play partner while in a place that they previously avoided showed a significant conditioned place preference toward that area as a result of playing there, spending nearly 200% more time in the area than before. Wilsson (1984) reported that puppies exposed to excessive inhibited biting in association with weaning were less willing to approach a passive handler. Also, the amount of growling received by the puppy was significantly correlated with a reduced willingness to fetch a ball, perhaps stemming from autonomic changes reducing

its ability to play. After the aggressive mother was taken away at week 8, her offspring were described as "noisy and violent" (112), consistent with the possibility that conflictive interaction may have installed a reactive autonomic tone. The coincidence of weaning with dramatic autonomic shifts, as indexed by heart-rate changes (see *Play and Autonomic Attunement*), suggests that during this period the puppy may be especially vulnerable to integrate autonomic disturbances via maternal mistreatment, perhaps damaging the offspring's ability to form secure attachments and predisposing it to express a reactive coping style. The quality and quantity of play during this period may represent a useful marker or indicator of risk for reactive problems, since competent coping in response to agonistic challenges appears to depend on the autonomic attunement that play appears to provide (Van den Berg et al., 1999) (see *Play, Social Engagement, and Fair Play*).

Audience effects and observational learning might further contribute harm by inculcating social schemata consistent with an aggressive or avoidant social orientation (see *Maternal Influences on Secondary Socialization* in Volume 1, Chapter 2). According to this hypothesis, the mother's behavior toward sibling rivals in association with conflicts over significant objects, resources, or locations may rapidly organize schemata and behavioral scripts matched to the scenes enacted between the mother and rivals. During demonstrations, bystanders observing the interaction might be assumed to acquire social information derived from watching, listening, and processing the proxemic exchanges between the mother and rival siblings. These demonstrations between the mother and sibling rivals should be of considerable interest to bystanders. Combining the direct emotional experience of previous maternal punishment (conditioned arousal component), coupled with observations of siblings receiving maternal punishment, a variety of complex emotional and behavioral propensities may be schematically etched into the puppy's memory and organized into prepared behaviors ready for rapid acquisition later on in life. In adulthood, these prepared behaviors and propensities may be enacted in response to situations resonating with emotional memories integrated in association with maternal punishment (see *Model/Rival Theory, Fair Play, and Sibling Hierarchy*).

Natal Environment and Autonomic Attunement

Subtle changes to rearing conditions may produce pronounced short-term and long-term modifications in a dog's capacity to cope with stress. For example, Wilsson and Sundgren (1998) found that changing the flooring material of the whelping box from cardboard to a soft piled blanket exerted a lasting effect on both puppy and adult temperament test scores, pointing to the important role of quality-of-life influences for mobilizing pronounced changes in behavior. The mere presence of a soft comfort object appears to contribute a positive regulatory influence on the development of autonomic tone. Puppies given a soft stuffed animal through week 4 showed less distress when they were left alone in a strange place with the comfort object than did puppies not provided such preexposure to the object (Marr, 1960). Marr (1964) also demonstrated that tactile, kinesthetic, and visual stimulation early in life alters the way puppies cope with emotionally provocative situations. As the result of being repeatedly petted, rocked back and forth, or exposed to a flashing light while facing a circular shape, 3-week-old puppies subsequently spent more time in close proximity with the shape and showed less emotional distress when tested alone with the shape at week 4 in comparison to nonstimulated controls. The stimulated puppies appear to have connected the circular shape with autonomic regulation incompatible with reactive emotional arousal. Marr's finding emphasizes the lasting subtle effects of early stimulation on the integration of sympathovagal tone with place attachments.

Appleby and colleagues (2002) have suggested an apparent linkage between natal environmental conditions and adult aggression and avoidance behavior in dogs. Questionnaire data provided by dog owners appear

to indicate that puppies obtained from nondomestic sources (e.g., commercial kennel) may be more prone to exhibit certain forms of aggression and avoidance behavior than are puppies obtained from a home environment (e.g., backyard breeder). Dogs acquired from nondomestic sources appear to be at an increased risk of showing aggression toward unfamiliar persons, especially while at home. These dogs also showed more aggression while receiving veterinary examinations. A possible explanation for such a linkage may be an increased sensitivity among puppies reared under nondomestic conditions to aversive stimulation and restraint by a strange person in an unfamiliar place. No relationship was extracted between the type of natal environment and intrafamilial aggression, suggesting that the combination of social and environmental familiarity may reduce the risk of reactive behavior associated with adverse developmental influences, whereas a lack of social familiarity or nervous attachments may increase the risk of such behavior. Puppies obtained from nondomestic sources at week 8 or later showed significantly more fear-related behavior than did puppies obtained prior to week 8.

These findings are consistent with the notion that vulnerability for reactive behavior is organized early in life (before week 8), and that subsequent experiences may augment or diminish reactive tendencies. First impressions are lasting, especially so for puppies between weeks 8 and 10 (see *Learning and Trainability* in Volume 1, Chapter 3), a time when many young dogs are taken to the veterinary hospital for the first time. Early aversive or frightening experiences may establish lasting anxiety-evoking associations with the hospital environment. Stanford (1981) found that 60% of dogs entering a veterinary hospital showed signs of fear and urinated. When restrained, many of dogs (18%) were classified as "fear-biting." These dogs showed reactive vocalization, efforts to escape, and aggression; 17% of the dogs were described as showing a willing entrance and controllable demeanor, but still urinated. Remarkably, only 5% of the dogs were observed to enter willingly and did not urinate (N = 462). These findings, combined with those of Appleby and colleagues, recommend that efforts be made to minimize young puppies' exposure to discomfort or frightening restraint (e.g., wobbly or noisy exam tables and scales) during veterinary visits, especially during the first few appointments. Puppies that show reactive tendencies during routine examinations should prompt appropriate counseling and referral to a cynopraxic therapist or trainer for supportive behavioral care.

Household Stress and Aggression

The adoption transition is often highly stressful for young puppies (see *Adoption and Stress* in Chapter 4)—stress that may be magnified by mishandling, manhandling, and excessive or inappropriate isolation and confinement (see *Dangers of Excessive Crate Confinement* in Chapter 2). Gantt (1944) observed that when dogs were moved from a farm or home environment to the increased confinement and reduced quality of life associated with the laboratory, they often underwent dramatic and persistent behavioral and emotional changes in the opposite directions of depression or hyperactivity, depending on their temperament and the balance of excitatory and inhibitory tendencies expressed. Excessive confinement within the home environment may increase behavioral reactivity in predisposed puppies. Although the effects of crate training and lengthy crate confinement and isolation on puppies within the home environment have not been studied, the preponderance of experimental evidence seems to suggest that stressful restraint, confinement, and isolation exert a problematic influence on a young animal's ability to cope with stress. Rats, for example, exposed for 21 days to 6 hours of daily restraint in a narrow wire-mesh tube in their home environment show significant changes in stress-related aggressive behavior toward cagemates (Wood et al., 2003). The experimenters found that the initial exposure to restraint had a sharply inhibitory effect on aggressive behavior toward cagemates; however, a trend toward increasing irritability and aggression became evident over

the next several days and significant by day 14. Aggressiveness continued to increase through day 21. Over this same period, the unrestrained controls showed less aggressive behavior toward cagemates. Excessive confinement and isolation may increase allostatic load while decreasing a dog's ability to cope with stress constructively, impair its ability to cope with novelty and uncertainty, impede its ability to form secure attachments with family members and the home, and promote reactive behavior. Aside from the potential emotional harm and welfare concerns associated with excessive crate confinement and isolation, dogs that are confined in zinc-galvanized wire crates may ingest potentially toxic levels of zinc by chewing or licking the crate (Goicoa et al., 2002). Both the zinc coating as well as "white rust" are apparently toxic (Howard, 1992). Dogs exhibiting serious impulsive aggression have been found to show significantly higher concentrations of plasma zinc (1.69 ± 0.49 μg/ml) in comparison to nonaggressive dogs (0.76 ± 0.16 μg/ml) (Juhr et al., 2003).

There is a natural attraction that inclines dogs to follow human leaders, to engage in give-and-take exchanges, and to participate in cooperative projects. Such relationships are associated with emergent affection, trust, playfulness, and the integration of secure social attachments. Under the influences of leadership and nurturance, the dog copes with human control efforts by integrating a voluntary subordination strategy (VSS) and cooperative relations with the human leader; whereas, in situations in which subordination is displaced by subjugation and coercion, the dog may cope by mobilizing an involuntary subordination strategy (ISS), giving rise to significant interactive conflict and adversarial fallout (e.g., anxiety, irritability, intolerance, and resentment) (see *Involuntary Subordination and Canine Domestic Aggression* in Chapter 7). Secure attachments and an adaptive coping style are necessary for dogs to construct a belief or *illusion* that the world is safe, orderly, and responsive to autoinitiated control efforts. Conflictive attachment dynamics, perhaps originating in the mother-offspring relationship and perpetuated by domestic social ambivalence and entrapment, may promote ambivalent (insecure/nervous) social and place attachments, incompetence, and a reactive coping style. These influences may diminish or eclipse the developing dog's ability to form a bias of safety to buffer nerves when exposed to sudden change or social novelty and to provide the confidence needed to organize competent social behavior under such adverse circumstances. Just as the mother's licking, nibbling, nudging, and affectionate attention toward her offspring appear to mediate an autonomic capacity to form secure social and place attachments in adulthood, supportive family interactions with the puppy may provide a protective influence against adverse developmental stressors, while helping to mobilize an affectionate and playful orientation toward social novelty, ambiguity, and unexpected change that is incompatible with reactive behavior.

Living Space, Proxemic Relations, Inattentiveness, and Autoprotectiveness

Just as the ideal canine mother exhibits a high degree of forbearance and consistency in the management of her offspring and their appetites, the human parent should set limits in the context of reward-based leadership and training. By emulating the mother's use of the least force and threat necessary to discourage obtrusive behavior, the cynopraxic trainer works to deflect and redirect competitive tensions into alternative outlets and avoids placing undue emphasis on punishment. Play and safe exposure to varied social and environmental stimuli at a young age are critical aspects of training dogs to respond confidently to unfamiliarity and uncertainty in adulthood. During interactive exposure, habituation and latent learning processes are constantly at work shaping competent sensorimotor gating and orienting functions. Habituation and latent learning provide a foundation for the organization of an adaptive coping style. Preventive-exposure training (PET) (see *Habituation, Sensitization, and Preventive-exposure Training* in Chapter 3) serves to transform the home and neighbor-

hood into places perceived as safe and coherent while concurrent integrated compliance training (ICT) helps to transform sources of interactive conflict into opportunities for reward and play.

Interactive conflict typically develops around activities that are intrinsically gratifying to the dog but that are incompatible with domestic control interests. Social and environmental conditions perceived as punishing (unrewarding) or unsafe, coupled with interactive conflict, stress (i.e., state anxiety and anger), and inescapability, may serve to transform the security of the home into a place of anxiety, anger, and entrapment. The resulting interactive conflict and stress may trigger various reactive and coercive strategies by the owner to prevent or suppress the unwanted behavior. Most of these efforts are aimed at depriving the dog of freedom or forbidding it access to the house. Depriving the dog of freedom of movement and access to the home and interaction with family members by excessive restraint or abusive training practices may temporarily empower the frustrated owner with an illusion of mastery but may actually do significant harm to the bond and degrade the dog's quality of life, as well as set the stage for more serious adjustment problems. Instead of learning how to predict and control significant events competently while learning to adapt and cope, the socially antagonized and entrapped dog may withdraw, become marginalized, and establish trigger *safe* areas within the home reserved for itself and preferred others, but that are defended aggressively against the intrusion of unwelcome others.

According to the foregoing hypothesis, many forms of intrafamilial aggression may be better understood and treated as originating from proxemic autoprotective incentives rather then hierarchical challenges or threats to the dog's perception of rank. Such aggressive episodes frequently occur without apparent provocation while the dog is resting in a favorite place or while in a location associated with or containing a prized object. Some of these dogs may also show strong threat behavior toward certain family members when the dogs are approached while inside a crate. The victim's mere presence or intrusion into a certain location may disturb the dog's mood and trigger impulsive autoprotective adjustments. According to a proxemic analysis, such attacks may be provoked by the victim's unwelcome intrusion into an intimate zone of comfort and safety in the absence of appropriate social affiliation or attraction. In some cases, dogs may threaten or attack in response to violations of social codes associated with interference while sleeping or resting or when in possession of objects (e.g., rights of first possession). In other cases, the dog's attachment to the place may be stronger than its attachment to the family member; in other cases, the family member may actively *repulse* the dog. While ensconced in such trigger areas, such dogs may permit access to certain family members with whom they appear to be strongly attached, while threatening or attacking other family members with little warning if they engage in intimate proxemic behaviors (e.g., pet, hug, cuddle, or pick up). The occurrence of aggression around locations providing the dog with emotional regulation conducive to comfort and safety (insecure place attachments), together with a state of reduced attention and unwelcome proxemic interactions, set the stage for a rapid vagal shift from inhibitory to excitatory arousal. However, instead of shifting back to a parasympathetic mode of relaxation, the impulsive aggressor may rapidly escalate into a catastrophic surge of sympathetic arousal and the phasic disinhibition of aggressive impulse. These observations suggest that impulsive aggression of this type may stem from regulatory attention and impulse-control disturbances affecting vagal tone. In general, dogs fitting this description rarely go out of their way to bite and typically bite only when approached or disturbed while in specific places associated with comfort and safety.

Although a subgroup of these dogs appears to be selective with respect to preferred targets and tends to focus attacks on family members, the notion that such dogs attack only household members is dubious, since many of these dogs will also attack nonfamilial visitors who violate defended trigger areas. Gershman and colleagues (1994) found that dogs with a

history of nipping or biting directed against family members were just as likely to attack nonfamily members. The tolerance that visitors and persons away from home appear to obtain, at least temporarily, is hypothesized to stem from the increased attention and interest that social novelty evokes in such dogs. Focused attention and social exploratory behavior is hypothesized to increase vagal tone, making catastrophic or explosive shifts of sympathetic arousal less likely to occur toward unfamiliar persons. The attentional disengagement and tuning out that impair impulse control and reduce sympathovagal tone appear to develop in association with three patterns of social interaction. Under the constraints of entrapment, dogs may cope with inescapable social anxiety and ambivalence produced by particular family members by actively ignoring them, a phenomenon referred to as *defensive inattentiveness*. The dog may also withdraw attention from family members that pay it little or no attention, a process of disengagement referred to as *reactive inattentiveness*. Defensive and reactive inattentiveness are closely associated with the withdrawal of social engagement, depersonalization, and the establishment of rigid social relations and roles.

Attentional and impulse-control processes are also adversely affected by social interaction that lacks consistency and relevance, causing the dog to actively disengage attentional resources from family members whose communicative behavior is irrelevant to the occurrence or nonoccurrence of significant events. Dogs also appear to withdraw attention and tune out from persons lacking competent leadership qualities. Family members who seek to establish control over the dog but who are unsure of their ability and proceed haphazardly or coercively (incompetently) may project ambiguity and mixed messages that are difficult for the dog to sort out and match with appropriate emotional establishing operations and response selections. Such ambiguity in the communication style of insecure leaders plays a prominent role in the development of social ambivalence and may help to explain the dog's aggressive response to seemingly benign signals. Proxemic signals given by an insecure or insincere leader may communicate a negative message despite a facade of friendly intent, perhaps expressing the powerless family member's underlying disappointment and resentment at failing to integrate secure affiliative power relations with the dog. The disengagement of attention resources from family members may impair socialization or reverse the effects of socialization, causing the dog to view family members as being increasingly unfamiliar via a process of depersonalization. According to cynopraxic theory, attention and impulse control are interdependent constructs that are closely integrated and attuned with autonomic processing. Orienting, attending, exploring, and playing activities serve to mediate enhanced familiarity, augmented sympathovagal regulation, and impulse control. In contrast, attentional disengagement and social avoidance result in decreased sympathovagal regulation, increased emotional reactivity, and lowered flight-fight thresholds. As the result of attentional disengagement, the approach of family members may trigger conditioned sympathoexcitatory shifts in autonomic arousal associated with interference and interactive conflict that have resulted in loss and risk in the past. The dog's efforts to ignore or tune out the person may serve only to relinquish impulse control and impair vagal control, perhaps via the activation of GABAergic neurons by arginine vasopressin (AVP) circuits at the level of the brainstem (Wang et al., 2002), resulting in the reduction of parasympathetic tone and generating a permissive state conducive to rapid sympathetic arousal and catastrophic autoprotective responses. Social ambivalence and entrapment dynamics may cause such dogs to defend the trigger area as an escape-to-safety refuge and default point of no return.

Social Spaces, Frames, and Zones

The living space or home range refers to the places routinely occupied or used by the dog and shared with others in the pursuit of everyday interests and reward. The living space of the home and surroundings consists

of local and global frames, spaces, and zones defined by individual attraction-repulsion dynamics and proxemic relations extending from the intimate safe center and moving outward to the unfamiliar and uncertain edge. Within the context of the home range itself, artificial global (e.g., walls and fences) and local (e.g. windows, doors, gates, and crates) frames define the spatial and physical contexts that set the stage for scripted social *scenes* or avoiding them (e.g., hiding behavior). The living space is framed into several social spaces distinguished by functional significance with respect to the sort of proxemic exchanges that the dog enjoys, tolerates, or might forbid depending on attraction, familiarity, and trust. Doors and walls artificially frame the home, thereby setting off intimate and safe spaces exclusive for use by family members to hide, rest, and obtain comfort (familial space), whereas fences globally frame the property and define an open and familiar space used to explore, play, and meet others (familiar space). The leash may be conceived of as framing a free-floating *intimate zone* between the handler and the dog and extending into the surroundings, representing variable degrees of familiarity and safety (transitional space). A satellite space containing the free-floating intimate zone is established wherever the handler and dog interact with each other. Finally, a training space is formed as the result of establishing a default hierarchy and leader-follower bond in association with limits set on pulling into the leash, jumping up, and biting on hands and clothing.

Most family dogs appear to treat visitors either as absentee pack members (insiders) deserving affectionate recognition or as intruding strangers (outsiders) warranting alarm and suspicion. Dogs that treat guests as part of an extended family-pack are typically highly demonstrative, exhibiting a high degree of social excitement and eagerness to make contact with people and other dogs; such dogs show minimal differentiation with respect to social space definition and represent a low risk of intrafamilial or extrafamilial aggression. On the other hand, dogs viewing visitors as outsiders often continue to exhibit a significant amount of wariness and aggressive readiness even after becoming thoroughly familiar with a visitor. Such a dog may accept and reciprocate friendly contact with familiar outsiders while in the yard but become reactive if they attempt to enter the house (violation of the familial space), especially if they are unattended by a family member. Also, such a dog may tolerate the approach of unfamiliar outsiders when away from home with a family member, but become strongly aroused if an unfamiliar outsider enters the yard unannounced (violation of the familiar space). Dogs combining a reactive vigilance for social novelty and sudden change (stimulation-seeking deficit), a propensity to discriminate aggressively between outsiders and insiders irrespective of familiarity, and a relatively low-fight threshold (trait anger) appear to be most prone to express a rigid watchdog script and extrafamilial aggression (see *Flexible versus Rigid Watchdog Scripts*).

Novelty, Sudden Change, and Reactive Adjustments

Escape to Safety versus Escape from Danger

Under natural conditions, the activation of phylogenetic survival modes mobilize drives that educe (not elicit) adaptive behavior, causing animals to strive against adversity and to take risks likely to improve their ability to survive and reproduce. For many animals, the neophobic stress evoked by unfamiliar stimuli and situations is overcome by forming a base of familiar and secure place and social attachments from where they can venture into unfamiliar surroundings by means of furtive sallies or more adventuresome journeys, depending on their ability to cope with uncertainty and risk. Knowing that they can scurry back into a hole or climb up a tree or fly away appears to increase the confidence of many animals to approach and explore promising novel objects. In any case, most animals appear to treat the exploration of novel objects and unfamiliar places as a source of risk and only take such risks to obtain a biologically significant advantage or reward. In nature, however, danger is at every turn and one cannot escape from its ubiquity; there are two primary solu-

tions: (1) escape to the security of the familiar and safe place or (2) confront the threat. Under threatening conditions perceived as inescapable with no hope of reaching safety, autoprotective panic or tonic immobility (behavioral helplessness) may ensue. Both of these reactive strategies to inescapable stressors are biologically organized to mediate adjustments to catastrophic situations where an escape to safety is blocked, leaving the animal vulnerable to extreme danger.

When startled and caused to flee, animals *escape to safety*; they do not merely *escape from danger*. This distinction is vital for understanding avoidance learning and how dogs learn to cope with novelty and danger. The fleeing animal is not stressed by the novel or fear-evoking stimulus per se but becomes distressed only if its ability to detect the threat is obstructed (i.e., reduced predictability) or its escape to safety is impeded or blocked (i.e., reduced controllability). If an animal can successfully dodge danger and escape to a secure and familiar place, it may slowly recover and return to the spot it had fled, taking significant predatory risks for the sake of increased food intake (Arenz and Leger, 1999). The validity of this notion of trade-off and flight to safety can be observed in the persistent escape and approach behavior of squirrels exploiting a birdfeeder; despite being repeatedly chased away by a dog and only narrowly escaping its teeth, a persistent squirrel does not appear to be rapidly deterred by the danger from returning to the feeder, nor does it show much evidence of fear while there. In fact, with every successful escape, the squirrel's confidence appears to grow, causing it to linger longer at the feeder before dashing off. The squirrel may even increase the frequency of its visits to the feeder, perhaps under the synergistic effects of appetitive reward and the reward of successful escape/avoidance. However, if the accustomed escape route is changed or blocked, forcing it to delay or take a detour, the squirrel will show a significant change in behavior as the result of the hindrance slowing its escape to safety. Subsequent to such events, the squirrel appears to take more time before returning to the feeder (if returning at all), becomes more vigilant while at the feeder (stopping to look and listen more often), and wastes no time in getting away from the feeder as soon as it detects the dog heading its way. Young squirrels appear to show far less vigilance than adult squirrels, evident from birdfeeder observations and also in the sluggish way in which they respond to other threats (e.g., cars). Arenz and Leger (2000) found that vigilance levels appear to be closely related to appetitive motivation and physical state, with squirrels fed a high-energy food (HEF) showing more vigilance than those fed a low-energy food (LEF). As the HEF squirrels matured, they showed greater body mass and were more vigilant than the LEF squirrels, suggesting that the malnourished and smaller LEFs were willing to take greater risks by reducing antipredator vigilance for the sake of increased food intake. Since vigilance is incompatible with eating, as the squirrel becomes increasingly vigilant and uncertain of its ability to escape the feeder location successfully, the tradeoff ought to become less attractive, with the squirrel gradually showing an escape-from-danger strategy and avoidance of the birdfeeder rather than an escape-to-safety strategy and approach to the birdfeeder.

The escape and avoidance behavior of squirrels appears to agree with experimental findings showing that safety functions as a reward in the acquisition of avoidance learning (see *Safety Signal Hypothesis* in Volume 1, Chapter 8). The acquisition of avoidance behavior varies proportionately to the relative length of time that an animal is exposed to danger and safety (Cándido et al., 2002). Under conditions in which the danger period is held constant, avoidance learning is slower when successful responses are followed by brief safety and more rapid when avoidance responses are followed by a longer period of safety (Cándido et al., 1989). If avoidance was acquired primarily as the result of escape from danger, then the relative duration spent in safety should be of little importance to the speed of acquisition, since the primary reinforcing event occurs at the moment of escape. As such, the safe situation need only confirm that a successful escape or avoidance response had occurred—information that should be of

greatest value at the moment the animal enters the safety box. An additional experiment varied the length of the danger period while keeping the length of the safety period constant. The results indicated that the acquisition of avoidance was accelerated if exposure to a dangerous situation was brief before the warning signal and shock were delivered, whereas acquisition slowed down if the time spent in danger was increased, causing a delay in the warning and shock. If escape from danger was the primary incentive underlying such avoidance learning, one would expect an opposite relation to prevail; that is, the longer the animal remained in danger, its motivation to escape should increase and thereby accelerate avoidance learning.

The pattern of avoidance learning just described is consistent with the notion that danger may function as a discriminative stimulus for an escape-to-safety response, whereas exposure to a lengthier period in the danger box may facilitate habituation and reduce the associative linkage between the box context and the postponed aversive event; that is, the danger box gradually becomes a safe box. The foregoing findings are consistent with an opposite extrapolation concerning the extinction of avoidance learning; namely, brief exposure to preevent danger followed by brief exposure to safety may exert a stronger influence on the disconfirmation of avoidance learning and the integration of abolishing operations than do lengthier periods of preevent danger followed by long periods of safety. According to this hypothesis, massed trials (brief danger > no aversive event > brief safety) should be transiently more effective than spaced trials (lengthy danger > no aversive event > lengthy safety) for mediating extinction, whereas, brief exposure to danger in anticipation of the aversive event followed by lengthy exposure to safety should produce the strongest avoidance learning. Consequently, repeated and massed exposure trials should work better to extinguish active-avoidance behavior, at least initially, whereas longer exposures to the danger situation followed by lengthy periods of subsequent safety appear to help habituate aversive contextual associations while consolidating incompatible expectancies predicting safety from the aversive event. Recent experimental work by Cain and colleagues (2003) supports the hypothesis that massed trials of extinction followed by spaced trials of consolidation training represent a more effective strategy for reducing fearful associations and avoidance than the converse strategy, but also see Martasian and Smith (1993) for variations affecting lengthy exposure versus distributed trials of response prevention.

Coping with Novelty and the Escape-to-Safety Hypothesis

The way in which mice cope with novelty also appears to support the escape-to-safety hypothesis. Mice are often described as being neophobic, but Misslin and Cigrang (1986) have reported that anxiety or fearfulness in response to novelty depends on how the novel object is presented. In comparison to mice that are physically placed into a novel situation and prevented from escaping to a familiar place, mice that are allowed to regulate how and when they approach and explore a novel situation from the vantage of a familiar place show little evidence of autonomic distress. Similarly, piglets cope with novelty by scampering as a group between familiar and unfamiliar areas, suggesting that the behavior may be a form of group play organized to enable the animals to explore novel areas and objects (Wood-Gush and Vestergaard, 1991). MacDonald (1987) found that wolf pups show significant individual differences in the way they enter into and explore an unfamiliar place. Among the pups studied, one showed a high level of confidence and willingness to enter an unfamiliar arena and explore novel objects (novelty seeking), while the others showed variable amounts of hesitation or reluctance (harm avoidance). The confident or leader pup appeared to facilitate other less confident pups to follow and approach novel objects, while fearful pups remained inside the start area. The way piglets and wolf pups explore and cope with novelty may reflect species-typical differences in the organization and function of their respective social hierarchies and the strategies that they use to hunt

and exploit environmental resources (Brown, 1966). For example, among field mice living in a natural habitat, social rank is closely correlated with differences affecting home-range exploratory behavior. Dominant mice range farther and explore the home range with greater confidence than subordinate mice. Subordinate mice were observed to stay out of the way of dominant mice and suspend object explorations if the dominant mouse was nearby. Among puppies, inappropriate punishment associated with house training may significantly alter their exploratory behavior and ability to cope with novel situations. In comparison to puppies trained with petting and food, puppies trained by blowing a puff of air into their ear or by rapping them with a rubber hose showed longer latencies to enter an unfamiliar area and explored by covering shorter distances at a time, suggesting increased tentativeness and anxiety (Matysiak et al., 1973).

In MacDonald's study, the leader pup was found to be the most successful of the group in its ability to control the bone in free-for-all dominance tests. The leader pup also exhibited the greatest confidence in response to the approach of a threatening familiar person opening and closing an umbrella. Pups that showed the greatest fearfulness toward the unfamiliar situation, refusing to enter the arena on their own or with the leader pup, exhibited the least fear toward a human stranger, whereas the leader pup showed the greatest fear toward the stranger. These findings suggest that there exist complicated relationships between social attraction and fear, nonsocial novelty seeking and harm avoidance, and dominance. In particular, an inverse relationship appears to exits between a fear of unfamiliar settings and things and a fear of unfamiliar persons. The relationship between social dominance and leadership in coping with unfamiliar situations and novel objects underscores the importance of leadership for facilitating exploration and learning. The follower/submissive traits mediating social subordination appear to be relatively independent, with the following being related to a fear of novelty and high social attraction and relative fearlessness, whereas submission is related to an inability to compete successfully over prized objects, perhaps as the result of being handicapped by a fear of unfamiliar circumstances. Wright (1980) reported a similar independence between competitive success and social dominance among German shepherd puppies. Like wolf pups, competitive success in the bone test is strongly associated with novelty seeking, but successful control over the bone does not necessarily predict social dominance (i.e., the ability to assert control over the behavior of littermates). Success in competition appears to reflect differences in motivation to possess and control the object (e.g., low-reward and high-reward incentive) and an ability to cope effectively under unfamiliar circumstances. One might extrapolate and predict that dogs exhibiting a high-reward incentive and history of competitive success, a low fear of unfamiliar places and novel objects, a high attraction toward familiar persons, and a high reactivity toward strangers would tend toward complete dominance, whereas dogs exhibiting a low-reward incentive and history of competitive loss, a high fear of novelty, and a high attraction toward unfamiliar and familiar persons would tend toward complete submission and dependency. Further, a history of competitive success, novelty seeking, and a reactive orientation toward strangers may predispose dogs toward social integration and extrafamilial aggression, whereas dogs with a history of competitive success, harm avoidance (bias for signals of punishment), dependency, and an attraction for strangers may be predisposed toward intrafamilial aggression and dispersal.

Collicular-Periaqueductal Gray Pathways and Reactive Adjustments

A subcortical pathway that might mediate sympathoexcitatory arousal in response to sensory input may originate in preattentive nonhabituating or slow-to-habituate collicular-periaqueductal gray (PAG) circuits. The superior colliculus (SC), an ancient midbrain structure located near the PAG, plays a central role in numerous integrative sensorimotor functions (e.g., prepulse inhibition) associated

with orienting behavior and rapid preemptive adjustments to expected and unexpected sensory events (*see Orienting, Preattentive Sensory Processing, and Visual Acuity*). Within the SC, multimodal cells responsive to visual, auditory, and tactile stimuli serve to map auditory and tactile inputs into a visuospatial coordinate system. The sensory maps represented in the SC are linked with motor maps that control involuntary eye movements and rapid preparatory motor adjustments (Dean et al., 1989). Under the influence of highly stimulating and disorderly environments, these sensorimotor processing functions may become sensitized, disorganized, and reactive. Pathways sensitized at the level of the deep SC and PAG appear to be of a nonhabituating type, perhaps due to inaccessibility by regulatory cortical networks needed to exert inhibitory control (King, 1999).

Inescapable events occurring unpredictably may be particularly prone to produce such reactive nonhabituating elaborations (e.g., noncontingent punishment), since they establish connections independent of predictive control expectancies and are perceived as inescapable. The unexpected occurrence of inescapable multisensory events involving visual, auditory, and tactile stimuli may trigger a summative effect that entrains nonhabituating reactions to the evoking stimuli present in the multisensory traumatic event. As a result of inescapability, the threat-arousing event may escalate to a defensive attack or panic, thereby integrating a deep subcortical nonhabituating circuit mediating reactive arousal and aggression. Consistent with the collicular-PAG hypothesis, the deep layers of the SC have been implicated in the expression of audiogenic "wild running" seizures resembling panic (Faingold and Randall, 1999), nonhabituating escape reactivity in response to repeated stimulation of the SC (King, 1999), and defensive behavior (Dean et al., 1989; Dringenberg et al., 2003). Stimulation of the SC via the optic nerve appears to mediate a rapid increase in blood pressure and heart rate (Cheng et al., 2001). More significantly, such stimulation also inhibits postevent vagal bradycardia—a state of sympathetic arousal consistent with the sustained activation of the flight-fight system. The SC probably contains phylogenetically conserved fields or submaps that mediate a preference for sudden change (e.g., sudden movement, looming overhead movement, loud noise, or striking/restraining actions against the body) and evoke phylogenetically prepared emergency adjustments to threatening stimuli (Westby et al., 1990). Studies investigating the electrical and chemical stimulation of the SC suggest that the area may initiate emergency motor activity and defensive behavior, perhaps involving the participation of the PAG (see Dringenberg et al., 2003). Interestingly, serotonin (5-HT) appears to exert a generalized inhibitory effect over the SC and PAG, suggesting that serotonergic medications may be particularly helpful in the treatment of reactive behavior stemming from dysregulation at the level of the SC and the PAG. Since the SC appears to play an important role in the mediation of prepulse inhibition of auditory startle (Fendt et al., 2001), dogs exhibiting reactive problems organized at the level of the collicular-PAG pathway may show sensorimotor-gating disturbances reducing prepulse inhibition to visual, auditory, and tactile startle events. Prepulse inhibition tests may be useful for identifying and differentiating such problems.

Orienting, Preattentive Sensory Processing, and Visual Acuity

The way dogs respond to fast-moving objects is probably strongly influenced by cognitive and preattentive negativity/positivity biases. The functional differentiation of cortical and subcortical processing of visual input may have significant implications with regard to how a dog responds to highly salient visual input associated with rapid movement and sudden change. Visual signals projecting from motion-sensitive receptor ganglions organized in the peripheral retina are relayed by dedicated pathways to the SC, where they undergo excitatory and inhibitory processing in preparation for the production of an orienting response or inhibition (habituation). Saccadic eye movements precede the orienting

response via a *target arc* formed between the sensory event and the frontal eye field located in the prefrontal cortex. Both the prefrontal cortex and the SC establish connections with premotor and motor nuclei in brainstem, which produce the motor signals that generate reflexive eye movements and orienting responses in anticipation of more complex behavioral adjustments.

Salient sensory input capturing attention is processed competitively based on species-typical significance and attractive/aversive (hedonic) value, with the vast majority of potential sensory events passing without notice. Out of the chaotic multitude of potential stimuli, the evocation of an orienting response signifies a selective organizing process narrowing possibility down to one orienting event and action at a time. Consequently, a sensory event may produce a saccadic alert, cause an orienting response, evoke a flinch, or release complex behavioral adjustments associated with surprise and startle (e.g., approach or avoidance). The process of selecting an appropriate response and suppressing all other responses to novelty (surprise) and sudden change (startle) is an important function of competent sensorimotor processing localized at the level of the SC and closely allied structures. As such, the SC appears to play an integrative role in organizing selective attention and sensorimotor-gating functions (e.g., prepulse inhibition) (Fendt et al., 2001), as well as mediating the expression of behavior operating under the influence of prediction-control expectancies. The SC encodes visual, auditory, and tactile sensations into multisensory maps in accordance with a visuospatial coordinate system. The resulting multisensory relations and fields are coordinated with motor reference points that initiate and guide orienting movement or complex adjustments toward sources of stimulation via the inhibitory and excitatory influences of the basal ganglia and the cerebellum (Niemi-Junkola and Westby, 2000).

In addition to conspicuous attractive and aversive events, positive and negative prediction error may increase eye movements and attentional focus on stimuli relevant to the refinement of prediction-control expectancies and the calibration of emotional establishing operations (Ikeda and Hikosaka, 2003). Prediction mismatches resulting in disappointment, threat, startle, or surprise intensify attention, evoke autonomic changes and shifts in cardiovascular activity, generate anxiety and frustration in association with behavioral conflict, and other emotional changes (e.g., anger and fear) congruent with the significance and the degree of deviation from the expected norm. These attention-activating signals enable dogs to adjust proactively and preemptively to predicted events. In reactive dogs, a preemptive and nonhabituating vigilance and anxiety bias may overshadow the acquisition of more positive expectancies toward social novelty and sudden change. Hypervigilant scanning appears to be preferentially dedicated to the detection of social objects, which are preemptively represented as potential threats (anxiety/threat bias). Vigilant scanning for social objects under an anxiety bias may essentially blind the dog to the recognition of safe social objects, thereby blocking learning that might enable it to discriminate nonthreatening social objects from threatening ones.

The dog's reactivity toward fast-moving and still objects may be linked to individual differences affecting visual acuity and discrimination ability. In addition to the influence of retinal variations on vision (e.g., size and complexity of the visual streak and central area) (see *Retina* in Volume 1, Chapter 4), dogs vary considerably in their ability to process visual information due to other causes. For example, to see clearly, the object image must be focused on the retina—not behind or in front of it, as in farsightedness and nearsightedness. One study examining the eyesight of German shepherds and Rottweilers found that more than half of the dogs tested were nearsighted (Murphy et al., 1992). Nearsightedness impairs a dog's ability to see objects detected at the *alert distance*, perhaps predisposing such dogs to respond to such events as intrinsically ambiguous and uncertain. With respect to objects that are located nearby within the *startle distance*, a dog's ability to form accurate retinal images rapidly decreases as the object moves within 20 to 13

inches away from the retina; objects (e.g., a child's face) viewed at a point closer than this focusing range may be blurred and require other senses to facilitate recognition (e.g., olfaction, hearing, and touch) (Miller and Murphy, 1995). Dogs expressing a sparsely enervated central area may be especially impaired in their ability to recognize nearby faces. Dogs with poor vision may rely on established expectancy biases to process the uncertain events, resulting in friendly acceptance or possibly a bite in the face. Casual tests (e.g., dropping small treats on the ground, throwing a ball, or tossing a toy or treat for the dog to catch) can give the trainer a rough idea of visual function; however, a veterinary ophthalmic examination should be performed in dogs suspected of exhibiting a possible visual impairment in association with reactive behavior.

SOCIAL ENGAGEMENT AND ATTUNEMENT

According to Porges (2001), the visual communicative facial and head movements that are exchanged during social engagement are mediated by a network of cranial nerves operating under the regulatory control of corticobulbar pathways and special visceral efferents originating in the ventral vagal complex (VVC). The VVC is a relatively recent mammalian adaptation, enabling social animals to match autonomic arousal levels to complex social exchanges and transactions. The VVC consists of the myelinated vagus nerve, the nucleus ambiguous, and the source nuclei of the social engagement system (SES). Prosocial interaction perceived as safe appears to activate the mammalian SES, producing a lowered heart rate and a general calming effect, whereas threatening or challenging social exchanges result in the retraction of the SES and the activation of disengagement or confrontational systems.

Whereas wiggle dancing and animated tail wagging are indicative of social confidence and friendliness, a lowered tail held stiffly between the legs indicates a state of apprehension and reserve. Similarly, an elevated head position is indicative of an excited and bright mood, whereas a lowered head position or *hangdog* look is associated with a dark mood (dysthymia). These sorts of kinesic indicators of emotion and mood combine in almost endless ways to communicate a wide range of social messages while mediating autonomic attunement or misattunement. The differential showing and concealment of the white of the eyes and teeth appears to be used by dogs to convey a wide range of signals while modulating social stress (see DeVries, 2003). Many of these signals are extremely subtle and brief and may pass unnoticed (e.g., winking) but may nevertheless exert variable antistress and autonomic attunement effects. For example, cow-eyed gazing in which the white of the eye is slightly shown in association with bright glistening eyes appears to signify contented and focused affection, whereas exposure of large portions of white with anxious staring and nose licking appears to reflect a highly stressful state. Fang flashing (a quick and subtle expression of social anxiety in which a fang is briefly bared) usually anticipates uneventful and nonthreatening *cutoff* transitions, whereas baring of the teeth into a steady agonistic pucker obviously conveys a significantly different message. Numerous subtle licks and slurps, grunts and sighs, or chomping or clacking noises, especially at the conclusion of certain yawns, appear to signify frustration at waiting or other delays. The steady expiration that occurs when a dog growls may exert a vagal braking effect on autonomic arousal that permits the target to move away safely, whereas the extended expirations associated with howling or whining may stabilize autonomic arousal and enable the dog to cope with confinement or restraint preventing it from gaining access to the attachment object while signaling the attachment object to come to its rescue.

Many of these social behaviors and displays appear to be used in coping with domestic interactive stress with the apparent goal of integrating social relations and attachments conducive to autonomic regulation. In contrast to constructive social exchanges, dogs showing social signals signifying a serious intent to attack, thereby precluding or terminating attachment relations, show a loss of

facial expressiveness and warmth, exhibiting a deadpan look of utter seriousness and determined resolve, backed by a steady and unflinching stare that locks on the target in an utter readiness to attack (Figure 8.1). In contrast to the flat, expressionless appearance of dogs preparing to attack, dogs prepared to engage in friendly social behavior express their intent with an invigorated and sustained attention (e.g., eye contact and social head tilt), intensified social engagement (e.g., jumping up), or displays aimed at evoking play (e.g., play bow and face). These various social behaviors are mediated in association with preemptive and preparatory arousal that reflects varying degrees of sympathovagal balance or imbalance and allostatic load resulting from attachment dynamics.

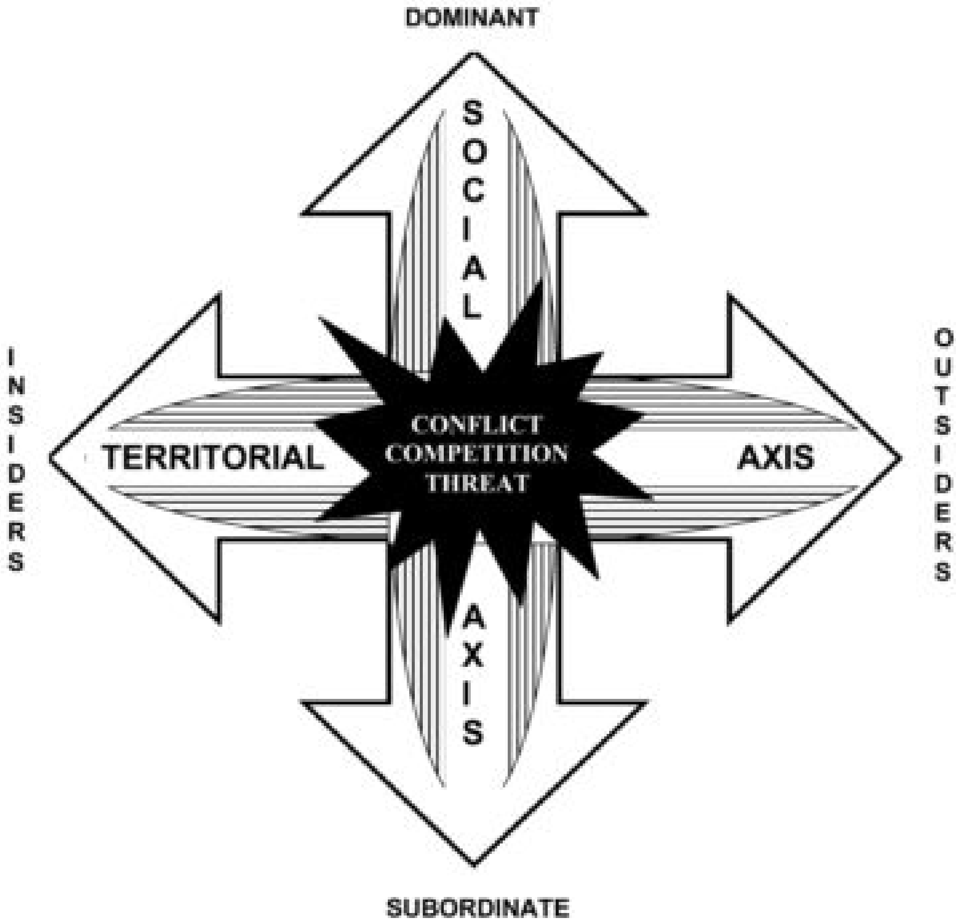

FIG. 8.1. Dominance hierarchy and territory serve complementary functions with regard to the regulation of aggression between conspecifics. The social distance between group members is achieved by means of vertical, hierarchical spacing via the establishment of social rank. Territory, on the other hand, defines the horizontal, physical space existing between competing groups. Whereas the dominance hierarchy is concerned with the regulation of aggression between group members, territory limits hostilities between members of competing groups. As a result, social dominance and territorial imperatives appear to share a common functional axis based on the need to establish cooperative group activity and to promote peaceful coexistence between neighboring conspecific groups.

The social head tilt is a distinctive canine social display of considerable interest. The social head tilt most often occurs in situations involving anticipatory excitement and intensified interest in the significance of the owner's vocalizations. Socially apprehensive and reactive dogs do not appear to exhibit the head-tilt response to human vocalization and generally show reduced capacities for sustained eye contact and other activities requiring social attention skills. Francis Barraud's famous painting, *His Master's Voice*, Nipper the dog is captured with his head cocked to the side in a rapt moment of looking intently into the horn of a phonograph. The action of tilting the head appears to be integrated at the level of source nuclei in the nucleus ambiguus that control the muscles of the middle ear and various expressive facial and head movements used to initiate and sustain social engagement (Porges, 2001). The middle-ear muscles are hypothesized to aid in extracting useful acoustic information from complex sources of auditory stimulation. The neural control of the middle-ear muscles is also linked with the regulation of facial expression, gaze, and vocalization. When the dog tilts its head, it may be attempting to concentrate on vocal sounds to identify familiar words and intonations associated with some anticipated activity. Gazing and talking to a dog in a manner that evokes a head tilt exerts a strong activating effect on the canine SES. The head-tilting behavior appears to be most robust in cases where the dog shows excitement and anticipation about something being said, suggesting the possibility that the head tilt may serve to help modulate arousal in situations of building anticipation and excitement. Sustained attention and evocation of head tilting, social gazing, talking, and other expressive movements of the face and head may exert a highly desirable invigorating effect on the SES while enhancing parasympathetic regulation over impulsive arousal. The intensified social gaze and attention associated with the head-tilt response should receive careful study as a conduit for social learning and the integration of secure attachments and autonomic attunement.

Oxytocin, Arginine Vasopressin, and Autonomic Attunement

Consistent with the autonomic regulatory function of social communication and engagement, oxytocin and AVP appear to play important roles in assessing the relative safety or danger posed by social situations. The social recognition and calming effects mediated by oxytocin probably play a central role in activating the VVC, promoting social engagement and attachment, and supporting group cohesiveness. Conversely, AVP may promote a bias of social anxiety and danger, especially when its release is triggered by ambiguous or uncertain situations in association with CRF while social repulsion or nervous social attachments are being mediated. A study involving humans is interesting with respect to a possible role of AVP in the discrimination of ambivalent social facial expressions (Thompson et al., 2004). Experimental and control subjects showed little change in their attentional or autonomic responses when shown photographs of neutral, happy, or angry facial expressions; however, subjects given nasal AVP showed a significant change in the activity of the corrugator muscle in response to neutral facial expressions. The corrugator muscle, located above the brow, is involved in the expression of anger. The authors suggest that the increased corrugator activity may indicate that AVP mediates an aggressive bias in response to neutral and ambiguous social facial expressions. In contrast, oxytocin appears to mediate an antistress bias of anticipated comfort and safety when exposed to social ambiguity and uncertainty (Windle et al., 1997; Uvnäs-Moberg, 1998).

AVP and oxytocin play important regulatory roles in the adaptive attunement of cardiovascular function to environmental and social threats and challenges. Central oxytocin mediates a slowing of the heart rate by increasing vagal tone via projections to the dorsal motor nucleus of the vagus (DMV), whereas AVP increases heart rate via projections to the nucleus of the solitary tract (NTS), probably via inhibitory pathways targeting GABAergic parasympathetic neurons (Wang et al., 2002). Whereas oxytocin

appears to produce a calming antistress effect via repeated exposure to social stimuli producing comfort and safety, AVP appears to mediate a self-protective vigilance in response to repeated exposure to social threat and loss. Oxytocin appears to switch on the SES as the result of interaction perceived as safe (Porges, 2001), whereas AVP appears to toggle off the SES and switch on the sympathetic-adrenomedullary system (SAM) in response to social challenges and threats (see Sewards and Sewards, 2003). The SAM system is phylogenetically older than the social engagement system. The passive response to defeat appears to be mediated by the dorsoventral vagal complex (DVC), which is described by Porges as a vestigial immobilization system and regarded as the most ancient of the mammalian arousal control systems. The DVC probably plays a prominent role in learned helplessness. The dynamic influences of AVP and oxytocin on cognitive, emotional, and social activity suggest that the neuropeptides perform integrative roles in the organization of behavior, perhaps via the activation of survival modes and modal strategies (see *Survival Modes and Allostasis*). AVP has been demonstrated to play a prominent role in the expression of territorial marking and aggression in hamsters (see *Arginine Vasopressin and Aggression* in Volume 1, Chapter 3), but its effects vary considerably from species to species, even closely related ones. For example, whereas AVP increases both intermale aggression and affiliative behavior in monogamous and nonterritorial prairie voles, it does not produce these effects in nonmonogamous and territorial montane voles (Young, 1999).

Arginine Vasopressin, Hyperkinesis, and Aggression

Although an overactive HPA system (allostatic hyperdrive and high cortisol) may mediate a disorganizing effect on a dog's ability to cope adaptively with social stressors, playing a major role in the elaboration of reactive aggression, other lines of research suggest that an underactive HPA system (allostatic hypodrive and low cortisol) may increase the individual's vulnerability to show impulsive aggression (see *Stress, Low Cortisol, and Aggression* in Chapter 6). Hypocortisolism may diminish adrenal feedback restraint over central AVP and CRF and trigger a variety of endocrine disturbances and behavioral changes associated with impulsivity (see *Stress, Low Cortisol, and Aggression* in Chapter 6). Children with attention-deficit hyperactivity disorder (ADHD) in combination with comorbid oppositional defiant disorder (ODD) exhibit reduced salivary cortisol levels in comparison with children not affected by ADHD (Kariyawasam et al., 2002). The difference, however, was only significant among a subgroup of ADHD children not taking stimulant medications, suggesting that stimulants may serve to normalize HPA-system tone. Among dogs, low plasma cortisol has been shown to elevate AVP and CRF (Papanek and Raff, 1994), perhaps representing a significant link between low-cortisol activity and autoprotective aggression (see *Arginine Vasopressin, Testosterone, and Serotonin* in Chapter 6). Sewards and Sewards (2003) formulated a model of defensive behavior and aggression based on the activating effects of CRF and AVP. Whereas central and peripheral CRF concentrations are postulated to trigger the defensive autoprotective mode, the central concentration of AVP is proposed as the primary trigger entraining the offensive autoprotective mode. A significant correlation between AVP and a life history of aggression has been established in humans (Coccaro et al., 1998), suggesting the possibility that a similar correlation may exist in dogs. Elevated CRF augments norepinephrine (NE) activity via the stimulatory action of CRF at the locus coeruleus (LC), leading to increased vigilance and sympathetic arousal. Dogs stimulated to induce anger show an increase in adrenal NE, whereas fearful dogs show a relative increase in adrenal epinephrine release (Verrier and Dickerson, 1991). Chronically blunted HPA activity may also gradually disrupt endogenous opioid restraint over CRF activity (Valentino and Van Bockstaele, 2001) or diminish 5-HT_2-mediated modulation of NE neurons (Done and Sharp, 1994). In addition to mediating an increased release of proinflammatory

cytokines, reduced cortisol levels have been linked with decreased heart-rate variability (HRV) in response to mild stress (Kunz-Ebrecht et al., 2003)—a diagnostic indicator of sympathovagal imbalance.

Increased AVP appears to elevate baroceptor set points significantly while reducing vagal tone (Michelini, 1994), a permissive cardiovascular background compatible with impulsivity and a reactive coping style. Corson and colleagues (1980) found that hyperkinetic dogs show various signs of *visceral turmoil*, including increased AVP release, rapid heart rate, panting, profuse salivation, and stimulant-responsive forms of impulsive aggression. This pattern of hyperexcitability and impulsivity in dogs was first observed and described by Pavlov (1928). He found that certain dogs exhibited spontaneous and constant salivation while restrained in the experimental harness. In addition, these dogs exhibited persistent efforts to escape and showed learning and appetitive disturbances—behaviors that Pavlov attributed to the frustration of an overresponsive freedom reflex:

> The conditioned reflex formed slowly, remained weak, and always fluctuated. The spontaneous salivary secretion continued, and gradually increased with each experimental séance. Also the animal constantly moved, struggling in every possible way in the stand, scratching the floor, and pulling and biting at the frame, etc. This was accompanied by dyspnea, always increasing toward the end of the experiment. (283)

Impulsive aggression associated with AVP-mediated antidiuresis and hyperkinesis has been successfully treated with stimulants (see *Two Case Histories* in Volume 2, Chapter 5, and *Pharmacological Control of Hyperkinesis* in this volume, Chapter 5). Stimulant therapy may be particularly useful in the treatment of impulsive aggression in association with severe socialization and habituation deficits (Corson et al., 1980).

STRESS, THYROID DEFICIENCY, HYPOCORTISOLISM, AND AGGRESSION

The chronic stress associated with social ambivalence and entrapment may profoundly affect neurophysiological substrates mediating the organization of canine coping styles. Stress-related modifications of 5-HT, dopamine (DA), and NE systems can exert pervasive effects on mood, attachment, and impulse control. In addition, the dysregulation of the HPA system may predispose dogs to develop a variety of behavioral and immunological disturbances (Padgett and Glaser, 2003). Changes affecting the immune system appear to be sensitive markers of stress. For example, salivary immunoglobulin A (IgA) levels have been shown to be an accurate indicator of acute stress reactivity in dogs (Kikkawa et al., 2003), with low IgA levels indicating a stressful state of arousal (e.g., exposure to the sound of vacuum cleaner), whereas elevated IgA levels may be indicative of a confident and adaptive orientation to novelty (Skandakumar et al., 1995). Another potentially useful physiological marker associated with immunological impairment (Muldoon et al., 1997), psychological distress (Chen et al., 2001), and impulsivity is cholesterol level (see *Fat, Cholesterol, Fatty Acids, and Impulsive Aggression* in Chapter 7). Penturk and Yalcin (2003) have reported that dogs with serious aggression problems show significantly lower total cholesterol and triglyceride levels than do nonaggressive controls. In combination with other diagnostic tools, IgA and cholesterol panels may provide useful indicators for exploring etiologies of stress-related behavior problems and refining treatment protocols.

Stressful conditions also appear to exert a dysregulatory effect over thyroid activity. In addition to metabolic regulatory functions, the thyroid appears to exert far-reaching influences on development and behavior (Meaney et al., 1987; Anderson, 2001). Subclinical disturbances in thyroid function have been linked to the etiology of a number of canine behavior problems, including impulsive aggression (Reinhard, 1978; Dodds, 1992; Fatjó et al., 2002). In addition to the adverse effects of chronic and acute stress, thyroid levels may be blunted by environmental contaminants, diet, and age (Reimers et al., 1990; Crockford, 2003). Strong evidence suggests the possibility that thyroid function may be

adversely affected by immune reactions produced by vaccinations (Scott-Moncrieff et al., 2002). After receiving vaccinations, antithyroglobulin antibodies are elevated, with some dogs showing concentrations comparable to the range observed in autoimmune thyroiditis. Whether these antibodies induce thyroiditis and damage thyroid function has not been demonstrated, but such an iatrogenic effect may be a real risk in susceptible dogs (Dodds, 2001). Hypothyroidism is the most commonly diagnosed canine endocrine disease, with at least half of all cases attributed to autoimmune thyroiditis (Scott-Moncrieff et al., 2002).

Impulsive aggression with subclinical hypothyroidism appears to occur most commonly with indicators of cognitive disturbance and may affect older dogs that were previously nonaggressive. Such dogs may show a heightened aggressive reactivity in response to unwelcome social interaction having an ambiguous character or seem to bite out of the blue. Among rats, antidepressant drugs have been found to increase thyroid concentrations selectively in the amygdala (myelin fraction), in contrast to other brain areas, which showed no significant change (Pinna et al., 2003). These findings suggest the possibility that the critical target site for the action of thyroid on behavior may be through the amygdala, a hypothesis consistent with certain types of attacks against familial persons in which the dog may fail to recognize the victim or misinterpret the significance of the person's actions. For example, the role of the amygdala in face recognition and the decoding of the emotional significance of facial expressions is consistent with the tendency of some of these dogs to snap at the face of familiar persons. Chronic stress putting the HPA system into allostatic hyperdrive and resulting in elevated plasma glucocorticoid levels may blunt thyroid activity, perhaps via glucocorticoid receptors expressed by thyroid-releasing hormone (TRH) cells in the hypothalamus (Swaab et al., 2000). On the other hand, hypocortisolism and allostatic hypodrive may also blunt thyroid function via autoimmune disease and thyroiditis (Tsigos and Chrousos, 2002). A possible linkage between hypocortisolism and hypothyroidism has been reported in Leonbergers (Smallwood and Barsanti, 1995). In addition, the incidence of hypoadrenocorticism (Addison's disease) appears to be relatively high in bearded collies (Sells, 1996; Oberbauer et al., 2002), a breed that shows a broad spectrum of behavior problems in association with thyroid deficiency and hypothyroidism, including aggression (Hamilton-Andrews et al., 1999). Although hypoadrenocorticism is regarded as a rare canine endocrinopathy (Peterson et al., 1996), subclinical hypocortisolism may be more common than commonly assumed. Plechner (1976 and 2003) has suggested that hypocortisolism is underdiagnosed and that dogs are afflicted by an incompletely understood polyglandular endocrine disorder that results in a chronic cortisol and thyroid insufficiency. In addition to producing too little cortisol, the adrenal cortex of affected dogs may release excessive sex prohormones in response to dysregulated adrenocorticotropic hormone (ACTH) levels. According to Plechner's hypothesis, plasma estrogens synthesized from these adrenocortical prohormones in turn bind with circulating thyroid (T3/T4) to further augment a health-threatening endocrine imbalance. Plechner claims to have treated 50,000 dogs and cats with a low-dose regime of glucocorticoid and thyroid replacement therapy but provides little documented evidence in support of his hypothesis. Nevertheless, given the apparent role of low cortisol and thyroid in the etiology of certain forms of impulsive aggression, more routine testing of thyroid, cortisol, and immunoglobulin levels (IgA, IgG, and IgM) should be performed in aggressive dogs.

A number of commonly used drugs (e.g., aspirin, diazepam, phenobarbital, and prednisone) have been reported to blunt thyroid activity in dogs (Ferguson, 1984; Daminet and Ferguson, 2003). Thyroid disturbances have also been linked to phenothiazines (e.g., chlorpromazine) and psychotropic drugs (Sauvage et al., 1998). Tricyclic antidepressants (e.g., amitriptyline and clomipramine) appear to produce a significant blunting effect on thyroid activity. A recent study found that clomipramine reduced T4 levels by 35% in

dogs over a 4-month treatment period (Gulikers and Panciera, 2003). The behavioral effects of such a reduction in thyroid activity are unclear, but they may be potentially problematic in dogs already showing compromised thyroid function or in dogs being treated for behavior problems with the antidepressant drug. Dogs exposed to long-term clomipramine treatment may be at an increased risk of developing thyroid-related anomalies, perhaps recommending that thyroid levels be monitored and appropriate actions taken to prevent thyroid-related problems from occurring secondary to clomipramine therapy (e.g., thyroid supplementation).

Diminished thyroid activity may reduce the efficacy of antidepressant drugs for controlling behavior problems in dogs, a problematic effect observed in human patients treated for depression (Henley and Koehnle, 1997; Cole et al., 2002). Several reports have noted the beneficial effects of combining thyroid with antidepressants to augment their effect. Interestingly, the tricyclic antidepressant imipramine, when given in conjunction with T3, exerts a significant down-regulating effect on the 5-HT_{2A} receptors (Moreau et al., 2001). According to Henley and Koehnle (1997), the low dosages of thyroid used to augment antidepressant effects in humans do not pose a significant risk of inducing a state of hypermetabolism. These observations suggest that CDA nonresponders to antidepressant therapy may benefit from a treatment program that includes low-dose thyroid. Given the apparent side effects of clomipramine therapy on thyroid function, together with the potential synergistic effects of giving the two medications together, it seems like a natural combination in the treatment of certain behavior problems.

Activity Success and Failure, Pavlovian Typology, and Coping Styles

Activity success in obtaining nurturance during early development may predispose puppies toward extraversion and fearlessness, active modal strategies (seeking and exploring), excitability, curiosity, playfulness, confidence, and social dominance, whereas social interaction resulting in activity failure may predispose the puppies toward introversion and fearfulness, passive modal strategies (waiting and hesitation), inhibition, insecurity, and social subordination. Both extraversion and introversion mediate adaptive social coping styles comparable to Pavlov's sanguine (s) and phlegmatic (p) types. The stability of these types depends on the support of secure social and place attachments (autonomic attunement) formed by social exchanges promoting comfort and safety (somatic reward) and the avoidance of loss and risk (p type), together with sufficient variability, flexibility, and novelty to support surprise via cortical reward (s type). The association of behavioral success with surprise, cortical reward, and increased active modal activity is consistent with Brace's (1962) notion that the differentiation of dog behavior is mediated by two primary behavioral traits—*activity success* and *general activity*—which can be conveniently collapsed into a single supertrait referred to as *activity-success seeking* (extraversion). Svartberg and Forkman (2002) have reported evidence that seems to support such a temperament-organizing supertrait associated with activity success and closely resembling extraversion. According to cynopraxic training theory, the invigoration of active modal strategies (e.g., seeking, investigating, exploring, and risk taking) via cortical reward (surprise) evokes elation and increased modal activity (extraversion dimension), whereas somatic reward (comfort or safety) and the emergence of passive modal strategies (e.g., waiting, hesitating, ritualizing, and risk-avoiding behavior) mediate calming, inhibition, and decreased activity levels (introversion dimension). The adaptive canine personality consists of a balance of s-type and p-type characteristics organized in the process of integrating autonomic attunement and secure social and place attachments. Social interaction conducive to autonomic attunement depends on an adaptive coping style shaped in accord with a principle of fairness and mutual activity success.

Broadly speaking, these observations suggest that the differentiation of s-type and p-

type characteristics is the result of changes flowing from social interaction promoting a perception that significant events are controllable by means of cooperation and that cooperative social exchanges are fair, whereas reactive dogs, corresponding to Pavlov's choleric (c) and melancholic (m) types, are differentiated by social exchanges that result in a perception that significant events are uncontrollable and that social exchanges are unfair. Reactive dogs are hypothesized to express two general reactive coping styles in response to social and environmental novelty and sudden change: (1) c-type dogs (unstable extraverts) combine a bold (fearless) bias toward novelty (neophilia) with risk taking, (2) m-type dogs (unstable introverts) combine a shy (fearful) bias toward novelty (neophobia) with risk avoidance (see *C-type and M-type Affinity for the Flight-Fight System* in Chapter 7).

C types are further differentiated into socially obtrusive and exploitative dogs driven by impulsive social and environmental seeking activities (exploiters), on the one hand, and socially impulsive and reactive dogs operating under the influence of autoprotective power-dominance motivations (despots), on the other. The lack of autonomic attunement resulting from social exchanges and transactions perceived as fair is an important source of impairment for reactive dogs. The autonomic attunement promotes selective and sustained attention, emotional autoregulation, and impulse control. Without the autonomic attunement afforded by the integration of secure attachment, a dog's ability to regulate impulsivity and reactive behavior competently is significantly degraded. Instead of hesitating and responding in accord with control modules and adaptive modal strategies, bold c types appear to perceive social novelty and sudden change as signals to prepare for uncontrollable appetitive or challenging events, causing them to orient in a state of preemptive readiness to exploit or confront under the invigoration of state anger (anticipatory frustration/irritability). Whereas exploiters are driven to get more, despots are driven to get and keep what they take. The presence of trait anger, reduced fear, and avidity for risk taking make c-type despots potentially dangerous (see *Flexible versus Rigid Watchdog Scripts*). M types are differentiated into socially hesitant and insecure dogs that are anxious and avoidant of social contact and emotionally withdrawn, depressed, or helpless. Whereas c-type dogs are driven to get and keep under the preemptive influence of exploitative motivations and autoprotective power-dominance motivations (trait anger), m-type dogs are driven to escape and avoid harm under the preemptive influence of autoprotective vigilance and readiness to flee (trait anxiety). Dogs expressing nervous attachments (autonomic dysregulation) show variable amounts of c-type and m-type behavior, with specific attributions based on the presence of trait anger (c type) and trait anxiety (m type) and behavioral threshold shifts resulting from social interaction producing state anxiety or anger. Under the influence of social interaction inducing anxiety (attention disengagement), c-type dogs may integrate m-type characteristics conducive to panicogenic arousal and impulsive aggression; on the other hand, m-type dogs may integrate c-type characteristics under the panicogenic influence of state anger (social disengagement) triggering catastrophic arousal and reactive aggression.

Activity success is capable of significantly altering general activity levels via the effects of cortical (elating) and somatic (calming) reward. In a sense, these two prominent types of reward can be characterized as expressing energy-expending and energy-conserving coping styles, orientations that may shift in accordance with social or environmental changes that favor expending energy to obtain an advantage at some risk or conserving energy to maintain known resources and avoiding disadvantages as the result of loss or risk. Finally, puppies showing s-type temperaments tend to be playful and independent, whereas those showing a p-type temperament tend to be affectionate and dependent. The significance of independence for developing puppies is linked with the formation of prediction-control expectancies and learning to adjust behavior in accordance with positive and negative prediction error, fair-play exchange, and autoattunement rather than merely seeking and receiving comfort and safety from a surro-

gate maternal object. The s-type orientation toward social independence, playfulness, exploratory curiosity, and spontaneity is probably strongly influenced by the quality of maternal care and the formation of secure attachments. The p-type orientation involving reduced playfulness, greater social dependency, increased affection and contact seeking, avoidance of risk, and reactivity toward ambiguous social stimuli reflects social and cognitive adjustments associated with the integration of insecure attachments. The vast majority of dogs express and merge both s-type and p-type characteristics while adapting to the social demands of domestic life. These changes are mediated via the differential inhibitory and excitatory influences of adaptive anxiety and frustration on behavior. An important goal of cynopraxic therapy is to balance and integrate s-type and p-type traits systematically. The canine personality is perfected by social interaction that promotes fairness while facilitating secure attachments (autonomic attunement), affectionate playfulness, mutual appreciation, and interactive harmony.

Proactive versus Preemptive Processing and Cynopraxis

Dogs operating under the influence of a reactive coping style respond preemptively and incompetently to social novelty and unexpected change as representing relatively uncontrollable opportunities, challenges (loss), or threats (risk), whereas dogs exhibiting an adaptive coping style tend to respond to similar circumstances under a preemptive bias of confidence and alertness for signals of reward. As the result of a history of activity success, adaptive dogs appear to acquire a buffer of tolerance or *adaptive optimism* that enables them to cope more effectively with uncertainty. Both strategies are subject to error, but whereas adaptive dogs tend to adjust to error in a proactive way, reactive dogs tend merely to react to error without learning from it. To borrow Rotter's terminology (see *Locus of Control and Self-efficacy* in Volume 1, Chapter 9), reactive dogs are external-type learners that respond impulsively, helplessly, or fearfully to perceived opportunities, challenges, and threats under a bias of event uncontrollability and uncertainty/danger, whereas adaptive dogs are internal-type learners that cope with change and novelty under a bias of event controllability and safety via the organization of prediction-control expectancies, calibrated establishing operations, and adaptive modal strategies.

The approach of a stranger appears to set off a three-way race between seeking-mode processing, flight/fight-mode processing, and stop-mode processing (Band and Van Boxtel, 1999). What a dog ultimately does is largely determined by the system that finishes processing operations first. If reactive processing is completed before stop-mode processing is finished, the flash point of no return may be reached, causing the flight or fight adjustment to escape from inhibitory control. The decision to exploit, attack, hold ground (engage in conflict behavior), or retreat is determined by reactive behavioral thresholds, ongoing arousal, and inhibitory coping skills. With increasing appetitive arousal the dog is likely to approach and exploit the object; with increasing fear the dog is likely to feel threatened and try to escape; whereas with increasing provocation the dog is more likely to confront the unfamiliar person. On the other hand, if the inhibitory stop processing is completed first, the reactive flight/fight-mode processing may be brought to a halt (all-stop signal) or after interrupting flight-fight processing an incompatible approach response may be produced (stop-change signal). Since the reactive response becomes progressively more difficult to cancel as reactive processing nears the point of no return, it is critical that stop-change processing be initiated at the earliest stage in the race.

Unfortunately, reactive dogs are problematic in this regard, since subcortical flight-fight processing networks may be maintained in a tonic state of preparatory arousal (vigilance and readiness to react) under the influence of reactive sympathovagal deregulation (sympathetic dominance), priming preattentive auditory, visual, and motor systems to process and respond to novel and ambiguous social signals with a negativity bias that causes the dog to perceive the developing situation as an signifying an uncontrollable challenge or threat. Pre-

emptive amygdalar activation (autoprotective anticipatory anxiety) stemming from aversive and traumatic emotional learning resulting from threatening events perceived as inescapable may support a chronic state of autonomic disturbance and nervous attachments that are incompatible with effective inhibitory stop or stop-change processing and social engagement. The preattentive and preemptive nature of reactive adjustments serves to support a tonic state of autonomic deregulation in support of a heightened state of vigilance and reactive readiness—changes that may require specialized cynopraxic procedures (e.g., target-arc training) to reboot and restore competent preattentive functions. A central goal of cynopraxic therapy is to integrate secure social and place attachments and autonomic attunement incompatible with reactive behavior. Together with the emergence of secure attachments and attunement that enable the dog to independently autoregulate sympathovagal tone conducive to an adaptive coping style, a number of bond-promoting quality-of-life changes are simultaneously introduced to activate survival modes conducive to social exploration and play. However, insofar as interactive conflict persists in the household, the amygdalar autoprotective circuits previously mentioned will remain active. Consequently, an important part of the cynopraxic process is ICT, with the goal of identifying sources of conflict, building a training space around them, and converting conflictive reward interests into shared opportunities for mutual reward based on fair-play cooperation and compromise, thereby systematically reducing social ambivalence and entrapment dynamics while increasing mutual appreciation and interactive harmony.

With the emergence of autonomic attunement, the dog transitions out of impulsive gratification to seeking activities organized to produce somatic reward, that is, outcomes promoting comfort and safety. The refinement of autonomic attunement is critically important for the experience of both somatic reward and cortical reward. Initially, surprise promotes exploitative modal activity that rapidly spirals into disappointment and loss. Within the context of an adaptive coping style, disappointment depresses modal excess (mania) and integrates passive modal strategies such as hesitation and delay of gratification, which, in turn, set the stage for better-than-expected outcomes and active modal activity that becomes increasingly focused, investigative, and experimental. These changes in active and passive modal behavior reflect a further refinement of autonomic balance, the organization of which moves the dog from manic excitement to elation. A similar shift toward stability occurs in passive modal adjustments, with the dog learning to process disappointments as information obtained while optimizing discovery, instead of reactively responding to them as threatening obstacles. Passive modal strategies enable the dog to seek, explore, and investigate without unduly sacrificing or risking loss of comfort and safety. Affectionate transactions and play gradually become the primary focus of cynopraxic therapy as a foundation of secure attachments is established. The balancing effects of affection and play on autonomic functions are profound and appear to open a healing space from where human-dog companionship facilitates a heightened state of well-being and mutual appreciation referred to as *cynopraxic joy*. As autonomic attunement becomes clarified and precise, human-canine interaction appears to become increasingly spontaneous, playful, and creative: liberated. The elation of discovery may now slowly or precipitously transition into the joy of becoming—a transition marked by a playful acceptance and rejoicement in the aleatory nature of life—and herald the opening of a paradoxical play space. Instead of seeking reward in prediction error or optimized control, the direct experience of ambiguity and uncertainty becomes the object of appreciation infusing everyday activities with a quiet sense of affectionate playfulness and freedom—a state of innocence that radiates from the heart of the dog as beacon for human betterment.

Barking, Motor Displays, and Autonomic Arousal

Whereas threat barking and piloerection may be used to advertise threats at a distance, the

growl is usually reserved for making threats at close quarters (Bleicher, 1963). Alarm and threat barking appears to be performed to affect the behavior of the intruder at a distance as well as to alert group members and to draw their attention to the situation (see *Behavioral Effects of Domestication* in Volume 1, Chapter 1). In addition to performing a coordinated defense function by alerting and arousing group members to a potential threat, barking may ward off intruders, perhaps causing them to avoid the area in the future. Alarm and threat barking may be rewarded by attracting the attention of family members or by stimulating the barking of other dogs (social contagion effect). Threat barking may also be rewarded by its ability to cause the intruder to withdraw from the defended area. Alarm and nuisance barking may be stimulating and intrinsically rewarding for some dogs. Motor displays are coordinated with barking threats, perhaps with the goal of disambiguating the dog's intent and strengthening the overall impression. The dog may thrust its front feet into the ground, giving the impression that it is straining to hold itself back, perform lateral shunts over a wide expanse of turf, intermittently charge forward and turn sharply about to snap angrily at the tail, and show a variety of threatening and shifting signs of intent indicative of reactive arousal. However, the most serious threat is a hard-to-describe but unmistakable "sick with repugnance look" that may present with some threat barking or other more subtle signs of aggressive intent.

The acoustics of barking vary according to context, type of provoking stimulation and arousal, and developmental factors (Bleicher, 1963). When responding to disturbances provoking alarm and aggressive arousal, individual barks are lower pitched, last longer, and are more rapidly repeated than barks associated with isolation and play (Yin, 2002). Alterations in respiration associated with different vocalization patterns may exert signature vagal effects on arousal levels via sinus arrhythmias. During inspiration, heart rate tends to increase whereas with expiration heart rate tends to decrease. These sinus arrhythmias are most evident while the dog is resting and reflect influence of breathing on vagal tone. The repetitive action of barking may modulate defensive arousal via afferent vagal feedback on forebrain and midbrain areas. The pressure and forceful cadence of threatening barking rhythms may contribute to the maintenance of a high level of state arousal and readiness, whereas the steady diaphragmatic pressure associated with whining and howling may serve to moderate or reduce emotional distress. This hypothesis suggests that canine vocalizations not only serve a communication function, but may also modulate the signaler's emotional state via a vagal mechanism. For instance, the squeak or yelp in response to unexpected discomfort may circumvent a reflexive aggressive response via rapid vagal feedback on aggression-mediating pathways. As such, the yelp appears to represent a bidirectional inhibitory stop signal, acting both internally and externally on the social source of aversive stimulation. Instead of attacking the source of discomfort, the well-socialized dog tends to respond to such events by yelping, thus appearing to give the doer of the aversive action the benefit of doubt.

The confrontational intent of the aggressive dog is accented by direct eye contact and pupillary dilation. Intent may be signaled at intermediate distance by a stiff gate and erect posture augmented by a bristling of hackles on the neck and along the back. Piloerection is mediated by sympathetic enervation of smooth muscles (arrector pili) attached to hair follicles. The contraction of arrector pili causes the hair shaft to stand up. Hackles make a dog look bigger and more formidable, perhaps increasing the dog's resource-holding potential and serving to intimidate a potential adversary. Unlike pupil size changes, which are under the combined influence of both sympathetic and parasympathetic control, piloerection is under the exclusive control of the sympathetic nervous system (SNS). Skeletal muscle tone and plantar sweating (indicated by sweat marks left on flooring) are useful markers of sympathetic arousal in dogs.

Dogs appear to organize a schema of safe and familiar expectancies that determines

whether they initiate friendly social engagements. In addition to barking at the approach of people and other dogs, dogs bark in response to unexpected stimulus change or mismatches between the usual or safe schema and an unexpected change (Adams and Johnson, 1995). The various mismatches between social and environmental stimuli and the accustomed safe and familiar expectancies of them produce varying levels of uncertainty, producing alarm, uncertainty, threat, and challenge. Alarm in response to environmental or social novelty and uncertainty may increase progressively or catastrophically, to borrow Zeeman's (1976) term, depending on the size and suddenness of the mismatch between the event and the familiar schema. Further, alarm barking may be evoked by the startle of sudden change or as a threat in response to a perceived challenge posed by the approach of an unfamiliar person. Threat barking is probably associated with an approach-avoidance conflict triggered by the approach of a stranger or the occurrence of a sudden change (e.g., strange sound or bell ringing). Many barking styles appear to reflect uncertainty and conflict of incompatible emotional and behavioral tendencies evoked by the approach of an unfamiliar person. Conflictive barking activity may allow the dog to hold ground, secure the stranger's attention, and keep the intruder at a safe distance, but without necessarily wanting to drive them away. As such, the barking response may delay social decisions about engagement, disengagement, or confrontation long enough to assess the relative safety and significance of the situation. Still other dogs will bark and continue to threaten persons with whom they are familiar but who are viewed as outsiders. Such dogs may tolerate a guest if the guest remains in the yard (the familiar space) but threaten a guest who comes in the house (the familial space). Finally, not all dogs bark to give alarm or threaten people, and many will bark just because they are intoxicated with the excitement of someone visiting the house. In fact, most barking by dogs in response to visitors to the home appears to be related to nonspecific excitement—not aggressive intent.

Variables Affecting Extrafamilial Aggression

Under the influence of confinement and restraint (e.g., when inside a car, crated, or chained) territory-like aggression may be invigorated (see *Variables Influencing Territorial Aggression* in Volume 2, Chapter 7). Children appear to be at an increased risk of serious attacks by chained dogs or by dogs that have broken free of chain restraint. Although keeping a dog continuously on a chain appears to exert a potent agitating effect—as Shaw (1906) says, "The chain makes a dog savage"—the results of a study performed by Le Boeuf (1967) in which dogs were periodically staked out and exposed to the approach of free-moving male and female dogs do not support the notion that chaining per se makes dogs more aggressive. Occasional and brief tethering outdoors is unlikely to produce adverse welfare effects or alter aggression levels, but the quality-of-life degradation, agitation, frustration, lack of gratifying social contact, and entrapment associated with excessive and routine chaining and penning of dogs outdoors may significantly increase a dog's aggressive propensities. A major source of increased risk associated with chaining is simply the result of increasing the public's exposure to an aggressive dog. Whereas a fence provides a protective, albeit imperfect, barrier, a dog on a chain is much more accessible to the approach of a stranger or an innocent child. Excessive confinement of a dog appears to reflect a failure of the family to integrate the dog effectively into the home.

Based on opinions that continuous tethering can be inhumane, the U.S. Department of Agriculture (USDA) has banned the practice of tethering in facilities that fall under its jurisdiction (Animal and Plant Health Inspection Service, USDA, 1997). To test the hypothesis that penning might be better for the dog than tethering, Yeon and colleagues (2001) performed a study that evaluated the behavioral effects of tethering and penning on Alaskan sled dogs. The study failed to show a significant welfare advantage from penning in comparison to tethering: "Our findings provide no evidence that tethering was any more or less detrimental to dog welfare than being

housed in pens (as recommended by the USDA)" (2001:268–269). These preliminary findings appear to suggest that both forms of confinement can be equally problematic when used to restrain dogs continuously. The report appears to raise significant welfare issues about the use of continuous pen confinement, as well as continuous tethering. Consequently, if tethering and penning are equally stressful, then alternative means of laboratory housing may need to be explored and recommendations made based on scientific findings rather than good intentions. Ultimately, however, as the result of the dog's special needs for human companionship, its highly developed social cognitive abilities, and its adaptation to domestic life, there may not be any practical way to house dogs under laboratory conditions that one can truly call *humane*, or honestly say that it serves a dog's best interests and welfare, without at the same time appearing painfully ignorant of the dog's nature and devoid of anything approaching sincerity with respect to laudable aspirations pertaining to animal welfare.

Social facilitation and inhibition appear to exert a significant effect on extrafamilial aggression. Two dogs aroused by the same provocative target may stimulate aggressive arousal in each other that exceeds what either of them would do if alone. The facilitative effect in such cases is often so strong that a third entity appears to emerge from the two, an effect reminiscent of the ferocious three-headed Cerberus, the mythical guard dog of Hades (Figure 8.2). The connection suggests a nice term for the social facilitation of extrafamilial aggression toward unfamiliar outsiders: the *Cerberus effect*. Dogs may also exert a significant, but less recognized, inhibitory effect on the barking behavior of other dogs. Scott (1983), for example, described an interesting situation illustrating the effects of social inhibition on territory-like behavior. He observed that when shelties and beagles were housed together, the shelties consistently became controlling over the beagles. Both shelties and beagles exhibit a very strong tendency to bark at strangers, but when reared together the more controlling shelties kept the yielding beagles from barking, resulting in "barkless beagles" (8). In other cases, social facilitation and inhibition might interact dynamically in the context of complex activities, such as predatory behavior. Dogs that might not otherwise be tempted into chasing or harming another animal may be caused to engage in such activity by the example of an aggressive model. For example, Christiansen and colleagues (2001) found that when a dog that did not chase sheep was paired up with a dog that did, the nonchaser invariably chased sheep. However, they also found that the presence of the nonchasing companion had an inhibitory effect on the severity of the attacks made by dogs that chase sheep when alone.

Conflicts and Rituals Toward Novel Social Stimuli

Ritualized activities such as barking, lateral pacing, and turning about often develop in association with the conflictive arousal and opponent behavioral dynamics evoked by the presence of an unfamiliar person or dog. The bark and motor responses may help modulate arousal (sympathovagal tone) and prevent a dog from reacting to the intruder prematurely or inappropriately. Instead of simply attacking, retreating, exploiting, or accepting the intruder's presence, the barking ritual may serve a number of adaptive coping functions by enabling the dog to hold ground, to *take time* to evaluate the situation, or to *kill time* to let the situation develop and become better defined before deciding what to do next. The ritual activates and maintains a state of general excitement and readiness conducive to several possible courses of action: emergency (flight-fight), acceptance (flirt-forbear), or exploitation. Whereas unstable and reactive dogs are prone to confront intruders or run away in accord with a negative expectancy bias toward unfamiliar persons, dogs operating under an adaptive coping style are more likely to respond to intruders in accord with a positive expectancy bias and response toward novelty (see *Expectancy Bias* in Volume 2, Chapter 3). Impulsive dogs operating under the influence of behavioral disinhibition may bark wildly and then exploit a visitor for anything they can get. Dogs operating under a reactive coping style tend to perceive social

FIG. 8.2. Territorial aggression can represent a serious threat of injury, especially when occurring under the influence of offensive incentives. This dog became aggressively aroused when approached and undeterred by the presentation of food, which he would eat and immediately return, threaten, and bite at the fence. As a puppy, he was removed from its litter shortly after birth and raised in a shelter environment until he was 2 months old, when he was adopted. The dog was returned to the shelter at 8 months after attacking and pinning his owner to the ground. The owner received several bites to her hands and arms. Over the course of the 2 years in the shelter, the dog became progressively reactive and could not be safely approached by anyone, despite efforts to socialize and train him.

novelty and sudden change as intrinsically threatening and respond to outsiders with preemptive preparations for social confrontation or disengagement via the activation of the flight-fight system.

Dogs showing a reactive coping style operate under the precarious influence of an unstable equilibrium between attacking and avoiding visitors that may rapidly and precipitously shift in the direction of one extreme or the other. Although such dogs may exhibit relatively stable behavior while under the influence of familiar circumstances and optimal levels of arousal and stimulation, they can rapidly transition into a fearful, irritable, or confrontational orientation when responding to an unfamiliar person perceived as posing a threat or challenge. Such dogs seem to jump from a "Who's that?" or "What's that?" orienting phase (e.g., sound of a doorbell or person standing up) to an impulsive reactive phase. Cognizant of the potential danger, the owner may attempt to comfort and reassure the dog in hopes of facilitating more friendly behavior or at least to prevent the dog from launching into an attack or retreating from the situation. However, like a double-edged dagger held upright on its tip by the support of a finger keeping it steady, the unstable equilibrium shown by such dogs can be immediately lost as the owner withdraws support or lets down his or her guard. The inflexible pattern of repetitive aggressive threats that such dogs sometimes show toward visitors holds more in common with a compulsion than an adaptive behavior operating in accordance with functional prediction-control expectancies and calibrated emotional establishing operations. To refer to such behavior as protective or territorial is rather misleading, especially since the behavior occurs independently of any apparent threat to family or property. In most cases, such aggressive behavior is probably better understood as an autoprotective response to the uncertainty evoked by the unexpected appearance and approach of an unfamiliar person. Conversely, an adaptive dog's positive orientation toward uncertainty via the formation of viable expectancies and competence may facilitate more friendly social engagement. For such dogs, the alarm-barking ritual gives way to a

control incentive urging the dog forward to seek reward by initiating social exchanges with the visitor. In an important sense, adaptive dogs are oriented toward the conditional significance of events in order to optimize reward opportunities and avoid punishment (i.e., loss of comfort or safety), whereas reactive dogs are more concerned with the here-and-now unconditional significance of appetitive and aversive events.

The unexpected appearance of the stranger or outsider sets the stage for interactive scenes between the dog and visitor that take place under the influence of a reactive bias of uncertainty and suspicion. Dogs showing deficiencies in their ability to habituate or cope with social novelty and strangeness often show a highly reactive orienting response that may become progressively vigilant and dedicated to a rigid watchdog script. Affected dogs appear to combine a sustained suspicion or suspense toward strangers, indicating an inability to habituate and to activate the social engagement system (SES), which may remain in a state of phasic retraction so long as the dog perceives the situation or the person as unsafe (i.e., strange). Without sufficient social attraction to offset repulsion toward visitors, the dog may take food from them but not integrate social relations incompatible with aggression toward them; in fact, some such dogs, especially those expressing trait aggression, may become increasingly dangerous as their fear is reduced by food. Just as prey animals can eat while remaining vigilant for predators, dogs in a persistent autoprotective mode will take food but remain ever vigilant and ready to launch an attack against any unexpected changes or movements perceived as a threat. The person giving food remains an outsider and continues to be perceived as a significant threat. As a result, even though the dog's level of fear may be reduced, the SES may remain off-line, so to speak, and prevent the integration of friendly relations. Many of the foregoing characteristics point to the possible involvement of vagal deregulation, whereby the detection of social novelty and unexpected change mediates heart-rate changes conducive to a rigidly defensive orientation that impair a dog's ability to process benign social events and respond with appropriately regulated behavior. Instead of responding with heart-rate deceleration when orienting and exploring a visitor, reactive dogs may fail to fully habituate but instead maintain a state of attentional vigilance and readiness characteristic of sympathetic arousal. Such dogs may have diminished HRV, reflecting reduced vagal tone and predisposing them to overreact to the slightest change in a visitor's behavior after they have apparently calmed down.

WATCHDOG BEHAVIOR

Aggression always occurs within a sociospatial frame of reference, but the reasons dogs show aggression are not always explicitly or obviously motivated by alloprotective or territorial incentives, although such incentives appear to exist in certain dogs. In many cases, aggression appears to be motivated by autoprotective incentives or merely represents an impulsive reaction to social novelty or sudden change without reference to redeeming territorial or social purposes; that is, the mere uncertainty presented by a stranger may trigger a preemptive wariness or evoke aggression in a predisposed dog. Alarm barking and threat barking are normal and useful when expressed appropriately, but under the influence of inadequate socialization or improper training, social novelty or unexpected change may generate a catastrophic shift in autoprotective arousal that sets off reactive adjustments that are impulsive and difficult to control.

Alarm at Uncertainty: Discriminating the Familiar and the Unfamiliar

The tendency of dogs to become wary and alarmed by the approach of strangers prompted Heraclitus to remark, "Dogs bark at the man they do not know" (Nahm, 1964:75). This rather prosaic observation, as characteristic of the Dark One of Ephesus, probably held a deeper significance for the cryptic philosopher than the obviously false notion that dogs bark only at people they do not know (see *Barking, Motor Displays, and Autonomic Arousal*). Plato also considers the

significance of knowing and not knowing as it relates to watchdog behavior in *The Republic* (Jowett, 1941). The subject is raised in the context of a philosophical discussion pertaining to the relationship between beliefs and actions. Socrates held that effective action depends on one's ability to discriminate between what is known and what is not known and then to act in accord with the former and to avoid the latter. In a dialogue between Socrates and Glaucon, the philosopher notes that these discriminative abilities are traits shown by a good watchdog:

> Many animals, I replied, furnish examples of them; our friend the dog is a very good one: you know that well-bred dogs are perfectly gentle to their familiars and acquaintances, and the reverse to strangers.
>
> Yes, I know.
>
> Then there is nothing impossible or out of the order of nature in our finding a guardian who has a similar combination of qualities?
>
> Certainly not.
>
> Would not he who is fitted to be a guardian, besides the spirited nature, need to have the qualities of a philosopher?
>
> I do not apprehend your meaning.
>
> The trait of which I am speaking, I replied, may be also seen in the dog, and is remarkable in the animal.
>
> What trait?
>
> Why, a dog, whenever he sees a stranger, is angry; when an acquaintance, he welcomes him, although the one has never done him any harm, nor the other any good. Did this never strike you as curious?
>
> The matter never struck me before; but I quite recognize the truth of your remark.
>
> And surely this instinct of the dog is very charming; your dog is a true philosopher.
>
> Why?
>
> Why, because he distinguishes the face of a friend and of an enemy only by the criterion of knowing and not knowing. And must not an animal be a lover of learning who determines what he likes and dislikes by the test of knowledge and ignorance. (375a–e)

According to the Socratic ideal, a good watchdog is the result of selective breeding for the mental and physical abilities that enable it to discriminate friend from foe and to act effectively upon that knowledge, traits that apply equally well to the selection and training of guardian rulers of the city-state. A watchdog must be vigilant for intruders and bold in its readiness to confront them. Such dogs must possess a physical size, strength, and fleetness sufficient to chase and subdue an intruder, while always treating those familiar to them with affection and gentleness. The tendency of dogs to show friendliness toward familiar people but hostility toward strangers was interpreted by Socrates as evidence of rational conduct. The dog's ability to discriminate friend from foe on the basis of relative familiarity and unfamiliarity, and then to act in accord with such knowledge, won the philosopher's admiration. The Socratic oath "by the dog of Egypt" is an apparent tribute to the dog's sagacity and ability to make fine social judgments based on the discrimination of what is known (recognized) and unknown (uncertain) about a person. The reference to Anubis, the dog god of Egypt, may allude to a canine power to search a person's heart and discern secret intent. Just as the judgment of Anubis served to grant or deny a deceased person access to the Fields of Peace in Egyptian mythology, the dog appears to play at least a symbolic role in determining whether a visitor is admitted into the home or turned away at the threshold.

Although it is certainly true in everyday life, as Heraclitus observed, that dogs often bark at strangers, some do not bark at strangers, and still others bark at persons they know well or just bark because they are excited by the approach of someone that they love. Further, although dogs are usually friendly toward people they know, many are also exceedingly outgoing and obtrusive toward people they do not know—the antithesis of Socrates's watchdog ideal. Finally, mere familiarity with a dog does not ensure friendliness, nor does it necessarily constrain the dog's animus. In fact, some dogs may even attack a familiar person without any provocation, perhaps only because the person intruded upon a forbidden social space or engaged in exchanges reserved for affiliated others. Nevertheless, the basic pattern described by Socrates appears to be generally faithful to the behavior exhibited by a great many dogs showing extrafamilial aggression:

whereas familiar people are recognized as safe and treated in a friendly way, unfamiliar people are regarded as a potential threat and treated with alarm and suspicion, even though the latter may offer the dog food and other rewards to reassure it of a friendly intent. Aggression targeting unfamiliar persons may occur with significant conflict and barking, or it may be triggered with no apparent conflict or barking. In such cases, as soon as the dog spots the intruder, it may fiercely rush the target and attempt to bite. Still other dogs may attack visitors only after appearing to have slowly accepted them. Dogs showing such behavior require lifelong supervision and appropriate physical restraint to avoid future attacks when exposed to unfamiliar persons or familiar outsiders.

Flexible versus Rigid Watchdog Scripts

Normally, social novelty and sudden change (e.g., unfamiliar persons in association with the ringing of a doorbell) evoke excitement and approach-avoidance conflict causing dogs to bark, followed by friendly resolution and approach, social investigation, and the initiation of reward-seeking behavior toward visitors. This familiar pattern of friendly proactive and prosocial behavior is disrupted in extrafamilial aggressors. Instead of merely hesitating and barking (ritualizing) before approaching and initiating prosocial introductory and exploratory behavior, the aggressor shifts instantly from alarm arousal evoked by sudden change or social novelty to a confrontational orientation, transforming a visitor into an object for the discharge of aggressive tensions and threats. Whereas most reactive dogs appear to warm up slowly to visitors (flexible watchdog script) and accept their approach and contact, other dogs (rigid watchdog script) may resist such accommodation and remain persistently on guard, even after repeated uneventful visits. Some of these dogs may appear to warm up to a visitor but then suddenly become aggressively aroused and threatening toward the visitor. The tendency of dogs that show a flexible or *habituating* watchdog script to warm up slowly to visitors and to show tolerance or initiate friendly behavior is consistent with the social novelty hypothesis. Such dogs rapidly and competently habituate to the novelty of an unfamiliar person and show an ability to initiate or reciprocate friendly social contact based on expectancies derived from the behavior of the visitor. The appearance of friendly tolerance can be deceptive, however, especially with dogs showing a rigid or *nonhabituating* watchdog script. Such dogs not only preemptively react to the strangeness of a visitor but also appear to discriminate between persons perceived as belonging to the household (insiders) and all others not belonging to the household (outsiders). Even as a dog becomes familiar with the visitor, it may refuse to integrate friendly relations with the outsider (see *Variables Affecting Extrafamilial Aggression*). In many cases, defensive and offensive components appear to conjugate in peculiar ways in such aggressors, whereby dogs operating under the influence of conflict and a rigid watchdog script may readily accept food and even tolerate petting from visitors but then shift back into an aggressive mode and threaten or bite them as they stop or attack from behind as a guest gets up to leave the house. Such aggressive behavior in response to an upturn of activity and sudden change appear to implicate a sympathovagal mechanism. The tendency of such dogs to threaten or bite visitors as they get up, when they approach the owner, or when they prepare to leave the house may be related to rapid shifts in autonomic arousal. Special precautions need to be taken and maintained until such aggressors show unambiguous signs of friendly acceptance toward the visitor.

Most dog owners appear to welcome a moderate amount of alarm barking and household protection as an added benefit of dog ownership. In some cases, wariness toward strangers is not only appreciated and encouraged, but the dog may gain a special status as the family's protector as the result of its territorial prowess. Unfortunately, aggressive propensities in the absence of proper training are often misdirected and turned haphazardly against family members or innocent persons visiting the home rather than against criminals (see *Incidence and Targets of*

Aggression in Volume 2, Chapter 6). Children are the most frequent targets of such bites, followed by passing adults, neighbors, and innocent visitors to the home (Blackshaw, 1991). Despite the dangers represented by untrained dogs, with appropriate training and socialization, the rigid watchdog type can be of tremendous value for personal protection and working purposes. In the hands of unskilled owners or busy households, though, such dogs represent a significant risk. In contrast to a reactive aggressor, a properly trained protection dog is a marvel of behavioral control and interspecies cooperation. As the result of effective training, the dog's aggressive impulses are systematically augmented and educated while inhibitory control is enhanced. Interestingly, dogs that have been skillfully trained in protection work are rarely presented with problems related to aggression. From a training theory perspective, integrating the aggressive impulse into a functional activity organized in accord with adaptive control expectancies and calibrated establishing operations represents a potentially valuable way to convert the conflictive or reactive impulse to threaten or attack into a proactive pattern of highly controlled protection behaviors. Such training appears to enable dogs to autoregulate impulses that previously operated under loose executive control. Systematic obedience and protection training shapes and integrates aggressive impulse into a proactive pattern of alert, threat, attack/attack-stop, bite/bite-release, guard, and denouement sequences. As an adjunct strategy, the goal of such training is not to make an extrafamilial aggressor into a protection dog, but to incorporate protection-training methodologies as a means to convert impulsive and reactive aggression into a more proactive form, making it responsive to contingent outcomes and inhibitory control. By bringing the aggressive impulse under instrumental control, an adaptive platform for subsequent behavior-therapy efforts may be established.

Although the combination of obedience and protection training may be a reasonable approach in certain cases, in the author's experience, the sort of commitment, dog sense, and experience needed to make such training a success is rarely found in average households. Further, improper handling and incompetent protection training may only serve to make a dog more dangerous and difficult to handle. Many legal and practical factors need to be carefully considered before recommending such a strategy, but with highly dedicated and responsible dog owners such training might be explored as an option in the treatment of dogs living under the right set of circumstances that justify the risks involved. Select dogs and owners that might benefit from such training are most likely to receive responsible guidance and competent instruction from trainers working in association with established schutzhund organizations.

Attention and Autonomic Regulation

Attentional processing of significant events is divided into four steps—target arc, orienting, sustained attention, and attention termination—that simultaneously coordinate autonomic and cognitive adjustments and the expression of changes to cardiovascular activity. In addition, attentional behavior is strongly influenced by the autonomic effects of interference (distracter stimuli) and interruption (diverter or disrupter stimuli). The detection of the target stimulus produces a rapid parasympathetic effect that is observable within the first beat after the stimulus is detected (Berntson et al., 1992) roughly corresponding to the temporal relation between the flinch-alert response produced by the S1 (squeak) and S2 (click) in target-arc training (TAT). In contrast to the rapid parasympathetic changes, sympathetic effects on the canine heart are more sluggish and may take 2 to 3 seconds or longer to develop (Berntson et al., 1992). The sympathetic phase corresponds to the flick, treat, and pet sequence in TAT (see *Attention and Play Therapy*). These findings indicate that autonomic processing is temporally partitioned in a way that favors the antecedent activation of parasympathetic circuits in advance of sympathetic ones in the process of organizing a controlled response to unexpected events producing surprise or star-

tle. In addition to autonomic partitioning, a dog's response to significant attractive or aversive events evoking surprise or startle appears to be moderated by the coincidence of nonevocative stimuli that occur in a close forward contiguity with the evocative event. In the case of startling stimuli, these antecedent neutral stimuli serve to attenuate fear responses evoked by the unexpected startle, an effect referred to as *prepulse inhibition* (see *Interrupting Behavior* in Chapter 1). As a result of the buffering effect on withdrawal behavior mediated by the antecedent stimulus, the previously neutral antecedent stimulus may enable a dog to cope more effectively with such sources of startle in the future, appearing to play an important role in the integration of passive modal strategies and proactive avoidance behavior. One might imagine that a similar effect is produced by antecedent stimuli linked with attractive stimuli producing surprise, but instead of reducing arousal associated with surprise, as in the case of startle, such antecedent stimuli linked preattentively with surprise may serve to amplify seeking incentives in association with the mobilization of active modal strategies.

These behavior-modulating capacities are reflected in preattentive bias and searching behavior, causing the dog to show a preferential alertness or vigilance for the detection of antecedent stimuli evocative of excitement or apprehension, thereby facilitating and setting the stage for an orienting or defensive response. Such preattentive biases are probably preferentially linked with neutral stimuli via a filtering process that excludes stimuli that are already associatively valenced with attractive or aversive bias, thereby preventing the cross-association of opposing arousal states. Such a filtering process would be necessary to guard against the confusion that would flow from an antecedent stimulus that evoked both excitement and apprehension at once or evoked inappropriately high levels of excitement or apprehension toward an event or stimulus warranting only minor attention, causing the dog to search inappropriately, unnecessarily, or persistently for significant events and impairing its ability to orient or engage selective attention capacities effectively.

These rapid preattentive gating and information-handling processes serve to invigorate attentional systems and tune autonomic motor systems for impending action. The adaptive changes configured in preattentive processing appear to profoundly influence a dog's capacity to hesitate (to "wait and see") and to selectively orient and attend to social and environmental stimuli and to extract significance from their occurrence for the optimization of prediction-control expectancies. In less time than it takes for the heart to beat, the eye to blink, or the puppy to yelp, autonomic circuits integrate a critical shift in arousal while mediating adaptive adjustments to environmental change. In contrast to the rapid deceleration effects of automatic targeting responses, the orienting response is associated with a slower inhibitory or excitatory effect on heart rate, reflecting the interaction of parasympathetic (vagal) and sympathetic influences on canine cardiovascular activity (Billman and Dujardin, 1990; Little et al., 1999). The orienting response is associated with a discrimination process, resulting in the differentiation of stimuli warranting immediate attention from those that do not, with the latter stimuli undergoing a process of habituation. Stimuli evoking attention activate cortical processing for evaluating an event's prediction-control significance and to stimulate an appropriate level of emotional arousal while selecting a measured and appropriate response. During periods of sustained attention, autonomic changes result in the stimulation, inhibition, and disinhibition of cardiovascular activity via gross and subtle changes mediated by sympathetic and parasympathetic divisions of the autonomic nervous system (ANS) on vagal tone. The various effects of cognitive and emotional processing on autonomic arousal and heart activity may index attentional effort and emotional establishing operations while matching arousal to behavioral needs. Among humans, sustained attention has a profound influence on vagal tone, which Porges (1992) has compared to partial atropine blockade, resulting in a phasic reduction in HRV. He found that children with attention and impulse-control deficits show disturbances in their ability to appropriately

adjust vagal tone while engaged in activities requiring sustained attention. In comparison to children not exhibiting ADHD, children diagnosed with ADHD exhibit increased phasic HRV, a difference that is removed by medication with the psychostimulant methylphenidate. The HRV during sustained attention shown by children with ADHD appears to reflect reduced mental effort in comparison to controls without ADHD, implicating an executive frontal role in the phasic modulation of vagal tone during sustained attention (Borger et al., 1999).

Attentive and preattentive functions play a profoundly influential role in the organization of adaptive and reactive coping styles. The critical interface between the external and internal environment is mediated by attention and the modulatory effects it has on autonomic arousal. External and internal environmental conditions exert a number of limitations on attentional resources that may lead to disturbances affecting a dog's impulse control, mood, and ability to cope with stress. According to cynopraxic theory, the aversive states of arousal associated with anxiety, frustration, anger, boredom, and depression are the acute (phasic) and chronic (tonic) correlates of attentional disturbances and autonomic deregulation impairing a dog's ability to achieve adaptive attunement and harmony via behavioral initiative. The quality of life (QOL) index is broadly correlated with the relative social and environmental order and variety, with extremes in either direction resulting in attentional disengagement, autonomic deregulation, and increased impulsivity resulting from anxiety (harm avoidance) and boredom (lack of stimulation or novelty seeking). Cynopraxic theory postulates that anxiety and boredom are the result of environmental conditions that lack sufficient order or variety to support attentional engagement. Accordingly, anxiety is the autonomic correlate of social and environmental conditions that lack sufficient order (consistency and predictability) to *support* attentional engagement, whereas boredom is the autonomic correlate of environmental conditions that lack sufficient variety (novelty and uncertainty) to *sustain* attentional engagement. In both cases, attentional disengagement results in reduced impulse control and behavioral changes tending toward depressive or compulsive disorder.

In addition to external social and environmental influences, internal drive conditions originating in overactive subcortical networks may overstrain attentional functions, causing them to develop an opposite pattern of incapacitation associated with an inability to flexibly disengage attention, to habituate to irrelevant stimuli, or to shift attentional focus selectively in accord with prediction-control expectancies. Reactive dogs appear to approach the environment in a rigid and one-dimensional way, showing a high degree of vigilance and readiness to act, depending on preattentive biases (positive or negative), preemptive arousal, and the behavioral system involved. Reactive dogs express four general patterns of hyperexcitability in association with an *inability to disengage* attentional processing: excessive seeking, exploiting, avoiding, and fighting. In contrast to reactive dogs, impulsive dogs are saddled with an opposite attentional burden resulting from social interaction that lacks sufficient consistency or clarity to form reliable prediction-control expectancies and calibrated establishing operations. Instead of being unable to disengage attention and relax, impulsive dogs appear to be motivationally disengaged from social stimuli. Operating under the influence of social ambivalence and loner/dispersive tensions, impulsive dogs may automatically disengage attentional resources, perhaps as a measure to protect cognitive processing from the adverse influence of information inadequate or inimical to the formation of predictive correlations. Dogs that respond to social proximity and contact with motivated efforts to disengage attention tread a perilous tightrope, because withdrawal of attentional resources is anxiogenic and tantamount to relinquishing control over impulse. The reactive or intentional disengagement of attention is hypothesized to result in blunted prefrontal activity and the deregulation of parasympathetic tone, a state of instability that is further amplified and complicated by the loss of social attraction. The retraction of the SES incurs the loss of emotional regulation and

vagal stability afforded by attunement with attachment objects, as well as mediating anger—the motivational state mediating social repulsion. As the result of the social and attentional disengagement, a dog may become increasingly vulnerable toward ambiguous or conflictive social signals, causing the momentary arrest of parasympathetic outflow and promoting a preparatory state of catastrophic arousal. The sympathovagal imbalance associated with the disengagement of attentional and social resources not only mediates generalized anxiety, the lack of autonomic stability exhibited by such dogs appears to contribute to increased moodiness, impulsivity, and changes in general activity levels.

Dogs with flexible attention skills can form and test prediction-control expectancies and adjust their behavior accordingly, thereby enabling them to anticipate events and to prepare emotionally in advance to behave in ways that are most likely to succeed. In contrast to the rigid adjustment styles of reactive and impulsive dogs, dogs expressing an adaptive coping style can rapidly shift expectancies and emotional arousal in order to keep pace with changing circumstances and, in doing so, optimize their ability to respond competently to significant events.

Play and Autonomic Attunement

The propensity to play is not equal among dogs. Dogs evidencing emotional and behavioral disturbances associated with anxiety, fear, and anger often show significant impairments in their abilities to sustain playful interaction with other dogs and people. Reduced exploratory behavior and playfulness may impair a dog's ability to cope adaptively with unfamiliar or uncertain situations, as well as diminish its ability to initiate or reciprocate competent exchanges needed for social engagement and integration of secure attachments with family members. A reduced alertness for signals of reward is characteristic of a reactive coping style, perhaps, by default, forcing such dogs to rely on signals of punishment and unconditioned sources of gratification. The emotional states associated with a reactive coping style (anxiety, anger, irritability, intolerance, and withdrawal) may simply reflect the mood changes that occur when a dog cannot effectively process and experience the rewards necessary to play and to actively learn.

The ability to play is probably organized at an early age. Among wolves, play fighting emerges as a prominent mode of social interaction in advance of fighting in earnest and the establishment of sibling hierarchy relations. In contrast, less sociable canids (e.g., coyotes, jackals, and red foxes) show more aggressive behavior and less play as infants than do wolves and dogs (Bekoff, 1977). Individual and breed differences affect a dog's propensity to fight. For example, Frank and Frank (1982) found that malamute puppies show "unrestrained fighting" (513) starting at week 2 and do not exhibit play fighting until weeks 4 to 5. Wolf pups exhibit an opposite pattern, with play fighting appearing during week 2, followed by a brief period of serious fighting between weeks 4 and 6. The malamute's adult predilection for intermale fighting may be attributable to permanent epigenetic changes affecting sympathovagal tone that stem from the ontogenetic timing and order of agonistic contests in relation to the emergence of play. Developmentally antecedent play may integrate an autonomic tone that enables dogs to cope less reactively with agonistic exchanges later on, whereas developmentally antecedent fighting or the absence of coemergent play may adversely sensitize and permanently bias dogs with a more reactive orientation toward social agonism. Highly sociable dog breeds appear to show more playfulness and less overt fighting than breeds prone to excessive interspecific aggression in adulthood. As a result, some dog breeds appear to be far more aggressive than wolves, whereas others are much less aggressive, reflecting breed differences and the effects of selective breeding pressures on aggressive propensities (Scott and Fuller, 1965).

Lund and Vestergaard (1998) found that the levels of play versus social agonism shown by dogs between weeks 6 and 8 is negatively correlated with the levels of play and social

agonism present at week 3 and weeks 3 to 4, respectively. In other words, puppies that played less at 3 weeks of age tended to play more later on, whereas puppies that fought more during weeks 3 to 4 fought less later on. Conversely, puppies that play less early on play more later on, whereas puppies that fight less early on fight more later on. These changes are attributed to compensatory rebound effects, but may just as likely reflect developmental processes and neurodevelopmental shifts mediating the expression of different temperament types. The developmental timing of play fighting and social agonism appears to exert a lasting influence on sympathovagal tone. A period of parasympathetic dominance emerging at around week 3 is followed by a brief sympathetic rebound between weeks 5 and 7, gradually moving toward progressive autonomic equilibrium through week 16 [see *Primary Socialization (3 to 5 Weeks)* in Volume 1, Chapter 2]. The autonomic fluctuations and behavioral rebound effects during these early weeks of development are reflected in significant heart-rate changes (Scott and Fuller, 1965), which are strongly correlated with changing emotional propensities that differentially enhance social attraction and play (parasympathetic dominance) or facilitate emergent social agonism and fear (sympathetic dominance). The physiological integration of mechanisms that facilitate neonatal thermoregulation may foreshadow the organization of regulatory systems dedicated to the control of sympathovagal arousal and flight-fight adjustments, suggesting the need for studies to track and correlate temperature variations with autonomic changes occurring during this period of development. Temperature changes in response to social stressors may provide revealing information and help to detect sympathovagal disturbances at an early age.

An improved ability to regulate sympathetic arousal is hypothesized to emerge during this integrative period of neurodevelopment, together with emergent social skills facilitating competent social interaction, engagement and bonding, disengagement and separation, and confrontation and defense. Accordingly, social attraction and the timing of play and fighting during these early weeks may exert lasting effects on the functional integration and relative equilibrium or disequilibrium of autonomic activity, thereby predisposing a dog at an early age toward sympathovagal balance or imbalance and the integration of an adaptive (proactive) or a reactive coping style in adulthood. Tendencies toward a reactive coping style may develop in association with autonomic imbalance resulting in either potentiation (allostatic hyperdrive) or blunting (allostatic hypodrive) of the HPA system, whereas an adaptive coping style appears to help integrate an adaptogenic response to stressors (allostatic normodrive). Finally, the energetic tactile stimulation associated with social play may contribute to the activation of an oxytocin-mediated antistress system. The canine flirt-and-forbear system is hypothesized to enable dogs to cope more effectively with stressors associated with social ambivalence and antagonism. Conversely, serious fighting between littermates may sensitize the AVP/CRF flight-or-fight system, perhaps reducing the ability of such dogs to form friendly and playful relations as adults. Competent social skills and trust appear to develop in the context of play, perhaps via adaptive parasympathetic attunement and vagal control developing in association with play activities.

Evidence supporting the hypothesis that autonomic tone is integrated at an early age and that it might exert a persistent influence predisposing dogs to integrate a reactive or adaptive coping style has been reported by Clark (1994), who studied the cardiac acceleration and deceleration responses of puppies exposed to brief restraint, elevation stress, and pain or startle elicited by tactile, auditory, and visual stimuli. Baseline heart-rate measures were obtained and compared with heart-rate recovery patterns. Puppies that showed emotionally reactive (anxious) temperaments, as indicated by owner reports and temperament tests, tended to return to baseline heart rates more slowly than puppies that exhibited less emotionally reactive temperaments. The study found breed and individual differences linking lengthier heart-rate recovery periods with heightened emotional reactivity, whereas

socially confident dogs tended to show briefer heart-rate recovery periods consistent with competent sympathovagal tone. These findings suggest that heart-rate and poststimulation recovery patterns may offer predictive or diagnostic markers for identifying puppies prone to integrate reactive coping styles, recommending the routine collection of heart-rate data as part of puppy testing.

Play in the absence of a principle of fairness and empathy degrades into cruelty and exploitation via a composite motivational influence of lust, greed, and power when unilateral advantages are sought without concern for the loss or pain suffered by the coplayer. The excitement of taking an advantage at the expense of the play partner appears to be an important motivational aspect of exploitative play, perhaps explaining why play sometimes slips into serious competition and overt fighting. A serious form of impulsive aggression exemplifies this tendency that may be shown by certain outgoing dogs bred for enhanced fighting propensities and expressing intrusive exploitative and power-dominance motivations toward unfamiliar persons. Up until the flash point, the dog may wear a "happy clown" face and only show evidence of a growing threat by an unmistakable attitude shift and increasing roughness, often matched with a deceptively charming "pretty boy" look and constant eye contact, seeming to lure the player in for more fun. Should the handler attempt to shift the play toward an advantage or abruptly stop, the intensity of the exchanges may torque up and suddenly turn into an all-out attack. The foregoing is one example of many types of situations where pseudoludic interaction may set the stage for aggression. Usually, play with such dogs is held off until a foundation of familiarity, cooperation, and trust is established. When play is initiated with a potentially aggressive dog, keeping the dog on tie-out and directing its play energy into an object is a useful precaution. Learning to trust ones "gut" is critical for avoiding dangerous situations such as the one just described. Knowing when to play or not is something that a trainer learns only with experience, close calls, and sometimes the wisdom born of hard knocks.

ATTENTION AND PLAY THERAPY

Dogs functioning under a reactive coping style appear to harbor negative biases that predispose them to process social uncertainty and sudden change as a threat or challenge rather than a potential source of reward. Affected dogs may be unable to habituate to the perceived threat of an outsider or may do so very slowly and only after many safe encounters. Reactive dogs of this type pose a significant risk of snapping or biting strangers or familiar outsiders who approach or attempt to interact with them too soon in the social familiarization process or approach them in unexpected ways. Such dogs may be particularly dangerous in unfamiliar situations perceived as unsafe and previously associated with loss, discomfort, or risk. Most behavior problems are shaped while a dog copes with aversive affects stemming from a history of interactive conflict and a failure to produce reward or to avoid punishment (activity failure). The Stoic philosopher, Epictetus (Internet Classics Archive, 2000), speaks to these distressful affects in his *Discourses*: "An affect is produced in no other way than by a failing to obtain that which a man desires or a falling into that which a man would wish to avoid … and by these causes we are unable even to listen to the precepts of reason" (3.2). Cynopraxic training and therapy efforts are organized with the goal of reducing the distressing affects of *failing and falling* and the consequent reactive adjustments to loss and risk by educating, in the words of Epictetus, the "faculty of pursuing an object and avoiding it, and the faculty of desire and aversion, and, in a word, the faculty of using the appearances of things" (1.1). Learning successfully to predict and control the environment serves to integrate an adaptive coping style, competence, playfulness, a bias of safety, and spontaneity, that is, the ability to autoinitiate prosocial behavior conducive to interactive harmony.

Attention Disturbances, Dissociation, and Orienting/Target-arc Training

The theory underlying the efficacy of orienting/TAT supposes that preattentive arousal

and submerged attentional functions mediating reactive adjustments are gradually linked and integrated into a network of cortical prediction-control expectancies and calibrated establishing operations in the process of mediating functional attention and impulse control. The process appears to reboot executive functions while enlivening the SES. A critical factor in this process is training the attention to orient selectively toward the flow of events with the purpose of detecting and appraising the significance of prediction error occurring in the context of purposeful behavioral projects and ventures, and appropriately adjusting behavioral output to accord with a preference for surprise (positive prediction error) and an aversion for disappointment (negative prediction error). Essentially, prediction error occurs when an anticipated outcome is better than expected or worse than expected, thereby mobilizing adaptive modal strategies aimed at producing more surprise (e.g., increased searching and exploration) while avoiding disappointment (e.g., hesitating and waiting). The systematic juxtaposing of a standard expectancy against appetitive events that variably result in verification or positive (surprise) and negative (disappointment) prediction error serves to enliven cortical learning functions and facilitate the organization of prediction-control expectancies and calibrated establishing operations (control modules). Prediction error results in hedonic as well as cognitive and behavior changes compatible with the optimization of activity success and the integration of an adaptive coping style.

Orienting/TAT appears to facilitate the integration of a selective-attention interface that enables dogs to sort out relevant from trivial input competing for attention during training. In the case of reactive dogs, the functional gating capacities that orienting/TAT appears to invigorate seem to help a more adaptive way to cope with novelty and sudden change. Once conditioned, the target-arc stimulus can be presented in anticipation of persistently evocative stimuli to modulate emotional and cognitive overload and prevent the default mobilization of reactive flight-fight adjustments. Orienting/TAT may facilitate the activation or normalization of pathways communicating between parallel preattentive subcortical circuits and attentive cortical networks mediating adaptive behavior in accordance with organized expectancies and calibrated establishing operations. Although these parallel cortical and subcortical systems appear to operate with a high degree of functional autonomy, they share a common autonomic axis that enables dogs to process sensory input and behavioral output in a motivationally coherent way. This organizing axis appears to be activated and modulated by orienting and attending behaviors. The attentional interface brings the demands and pressures operating within and without dogs into directional (drive) and functional alignment and tunes autonomic arousal to accord with changing needs. Adaptive orienting and attending result in increased parasympathetic tone (relaxation), whereas reactive orienting and defensive vigilance result in sympathovagal imbalance (muscular tension and a persistent readiness to act), as reflected in heart-rate changes and indexed by HRV(Billman and Dujardin, 1990; Porges, 1992).

Many of the therapeutic benefits of attention and play therapy are probably mediated through classical conditioning of sympathovagal tone. However, instrumental control over significant events plays a critical role in the way dogs respond to predictive signals. Whereas signals anticipating unconditioned aversive or appetitive events that are perceived as uncontrollable result in sympathetic tone shifts that promote reactive (escaping and confronting) and impulsive (seeking and subduing) adjustments, signals anticipating unconditioned aversive or appetitive events perceived as controllable result in parasympathetic tone shifts that are conducive to proactive adjustments and calming effects. Both appetitive conditioning (Hunt and Campbell, 1997) and aversive discrimination training (Billman and Randall, 1981) produce autonomic changes, evoked by conditioned stimuli, that are consistent with the requirements of an adaptive coping style.

According to cynopraxic training theory, the integration of prediction-control modules results in autonomic attunement and the

adaptive optimization of behavior. In combination, cynopraxic procedures refine selective attention and executive impulse control, increase adaptive modal activity (e.g., social and environmental exploratory behavior), foster optimistic expectancies to social ambiguity and uncertainty, integrate secure social and place attachment, and promote autonomic attunement and autoregulation.

The orienting/TAT procedure can be used to modify preattentive priming effects that negatively bias dogs to respond reactively to visual and tactile stimuli (e.g., sudden change, gestures, body movement, touching, handling, and restraining). To reduce preemptive and reactive processing, evocative stimuli are cross-associated with the auditory target-arc stimulus. The auditory target-arc response is linked with the earliest alert-intention movements shown by the dog in response to the visual signal. For example, in the case of preemptive reactivity to sudden hand movements, the target-arc stimulus (e.g., smooch) is presented just as the dog turns its attention toward the hand movement, followed rapidly by a click, right-hand flick, and delivery of a highly valued reward enclosed in the right hand. The presentation of the well-timed target-arc stimulus and reward immediately following the sudden movement serves to integrate the visual event into a positive network of preemptive associations and expectancies previously established during orienting/TAT. Additional confidence and attraction to the hands is promoted by using the hand as a target stimulus to guide the dog into various postures or movements before delivering the reward. As reactive processing is replaced by improved executive attention and impulse control, controlled exposure is more likely to succeed in organizing adjustments consistent with stable emotional equilibrium and social competence.

Reward: Standard Expectancy and Surprise

The orienting/TAT procedure appears to gradually integrate an attention-axial interface between cortical inhibitory networks and subcortical excitatory loops processing surprise and mobilizing exploitative seeking behavior via the repeated presentation of sequentially ordered events that provide a high level of predictability, controllability, and potential for producing surprise. Cortical surprise is hypothesized to require the existence of a previously established control expectancy, a calibrated establishing operation, and an action, collectively referred to as a *control module*, against which response-produced outcomes are compared, mismatches detected, and the new information integrated into the flexible control module to optimize the dog's future control efforts (see *Prediction Error and Adaptation* in Chapter 10). Orienting/TAT is initiated with a food reward of the least value and smallest size necessary to maintain an orienting/approach response (control module) while conditioning the bridge signal. This reward is referred to as the *standard expectancy* (SE). The SE provides an informational backdrop for comparing the relative value of outcomes produced and for detecting mismatches or positive prediction errors signifying better-than-expected outcomes and surprises. Food rewards of variable sizes, types, and presentations are randomly interspersed among rewards matching the SE value. Whereas orienting stimuli and the food reward are varied, the conditioned reinforcer (e.g., click/"Good") remains constant. The procedure is designed to enhance incentive, promote autonomic attunement, and invigorate attentional functions with cortical reward (surprise). The vocal bridge signal "Good," spoken in a chirped form, is paired with the rapid opening of the hand (visual target arc) and the delivery of the food reward and petting. The vocal bridge signal is also used to support eye contact and sustained attending behavior. Once an attending response (briefly sustained eye contact) is established with the dog's name/smooching and the vocal bridge "Good," talking to the dog, winking, smiling, and head tilting appear to further stimulate the canine SES. A useful technique for transitioning into play is to incorporate directional cues (e.g., gazing, pointing, leaning, and orienting) toward play objects in advance of walking and running toward them. Pointing or looking toward some spot before throwing

the play object in that direction can also help to stimulate interest and coordinated engagement. Directional cues are further integrated as signals by using them to help a dog solve problems (e.g., helping a dog to find a hidden food item). Training a dog to turn right and left, to back up and move forward, and to move in a wide circle so that it is facing away before signaling it to orient can enhance attention control while providing useful preliminary training.

Eventually, the orienting response is integrated into other training objectives (e.g., come, sit-front, eye contact, and following routines) by delaying the bridge until the target behavior is emitted or prompted, whereupon the bridge signal and terminal reward are delivered. As previously discussed, the surprise and active modal strategies emerging in association with orienting/TAT are hypothesized to mediate a cortical/subcortical attention interface or *operant/respondent axis* comprised of instrumental and classical elements (see *Defining Insolvable Conflict* in Volume 1, Chapter 9). As a result of the repeated evocation of surprise associated with the target-arc response (flinch alert), a network of cortical synapses are gradually interwoven into submerged attentional functions, thereby bringing preattentive arousal and reactivity under the modulatory and normalizing influence of executive control. As this critical conduit of information exchange between these parallel neural processing systems is strengthened in the context of orienting/TAT and other cynopraxic therapy efforts, a backbone of order and variety appears to form that enables the dog to engage in greater spontaneity and to show an increased capacity for play and social engagement. The efficiency of orienting/TAT for increasing social spontaneity, play, and social engagement is often nothing short of extraordinary, making it one of the most powerful tools currently available for moderating reactive behavior and integrating an adaptive coping style. To describe the effect of orienting/TAT most succinctly, the dog simply appears to wake up. To attain the multiple cortical and SES benefits of orienting/TAT, the target-arc alert/flinch response may need to be evoked and rewarded several hundred times. When performed properly, preliminary orienting/TAT provides a useful platform for all subsequent reward-based training and cynopraxic therapy efforts. The orienting signals used during orienting/TAT gradually become potent stop-change countermand signals, while the conditioned click and flick bridging signals are enhanced by the attention-focusing influence of such training. The simple shaping procedures used to promote attending and following behavior target and encourage autoinitiated behaviors that improve a dog's sense of control over significant events.

The repeated presentation of contingent rewards (e.g., food and petting) in accord with a standard expectancy, periodic surprise, and occasional disappointment contributes to the organization of an adaptive coping style, biasing the dog to search for signals of reward rather than signals of punishment. Along with surprise-seeking adaptive modal strategies, passive modal strategies are organized by such training toward the adaptive goals of securing reward gains at a minimal risk (i.e., avoiding unnecessary risk taking) and learning to cope with inevitable delays and setbacks (delay-of-gratification skills). Finally, the repeated activation of appetitive and social reward pathways in association with orienting/TAT may mobilize the oxytocinergic antistress system, contributing to feelings of comfort and safety, calm, and well-being (see *Adaptive Coping Styles: Play, Flirt, Forbear, and Nip* in Chapter 6). Orienting/TAT and social engagement therapy also include frontal approach, attending behavior (making and holding eye contact), and submissive ritualizing (sit-stay and down-stay) brought under the control of hand and vocal signals. Reciprocal frontal orientation and mutual gazing appear to initiate a communicative orientation unique to the human-dog relationship, thereby laying the foundation for following, cooperative problem solving, mutual appreciation, and interactive harmony.

The orienting/TAT procedure appears to provide significant benefits for the treatment of a variety of canine behavior problems stemming from attention and impulse-control impairments (see *Locus of Neurotogenesis* in

Volume 1, Chapter 9). The obvious similarities between some of these problems and human psychiatric disorders suggest the possibility that orienting/TAT or similarly organized procedures may have therapeutic value in the treatment of certain of these disorders. Also, many of the social engagement and learning deficits associated with autism are consistent with an axial dissolution between cortical regulatory networks and various subcortical attentional loops necessary for initiating and sustaining social cognition, communication, and engagement. Whether intensive orienting/TAT might provide similar benefits in such cases is unknown; nevertheless, the procedure appears to offer exciting possibilities and novel applications that warrant future investigation.

Attention Therapy, Orienting/TAT Procedures, and Play

1. Target Arc, Orienting, and Approach

A squeak or smooch (S1) sound is followed immediately by a click (S2) and a flick of closed right hand (S3) as the dog orients toward the trainer. The duration of the target arc is approximately 200 to 300 msec, a very rapid succession of events. Although the S1 is presented in various ways from a soft to loud squeak, the timing of S2 is kept constant. The flick and reward combination is variably delayed to occur 1 to 5 seconds after the dog orients.

Orienting and approach to the closed right hand is rewarded by the bridge "Good" spoken just before the hand is opened to reveal the treat.

The SE is established with the smallest effective reward needed to maintain orienting and approach behavior.

Better-than-usual rewards consisting of changes of type, size, context, and delivery are periodically given to produce positive prediction error and incentive shifts (Flaherty, 1996). The cortical reward (surprise) associated with positive prediction error is a critical factor in cynopraxic therapy. In addition to reorienting the dog to reward signals, cortical reward generates active modal strategies that enliven social behavior and promote play.

Forward movement activates the seeking system and is an instrumental part of orienting/TAT. Signaling the dog to orient and thereby to break off the direction of forward movement and to turn toward the trainer has the effect of making the trainer the object of seeking. The effects of this simple stop-change procedure on cognitive function and social engagement are profound and pervasive (see *Attention and Impulse Control* in Chapter 1). The procedure appears to access preattentive cognitive processing, organizes stop-change inhibitory processes, intensifies associative conditioning of the click-and-flick bridging signals, serves to promote feelings of comfort and safety, and activates the SES. In a sense, the squeak and click stimuli result in a series of activating and organizing effects that are analogous to the effect of turning a key to start a car. The simple action of turning the key produces a number of automatically coordinated events that lead to the engine starting and the car working under the guidance of the driver.

2. Frontal Orientation and Coming

As the dog orients and starts moving toward the trainer, the vocal signal "Come" is spoken just before flicking the right hand out to the side.

3. Attending and Submissive Rituals (Sit-Stay Training)

The dog is periodically prompted to sit-front after coming and to make eye contact in response to its name or smooch sound before the bridge "Good" and reward are delivered. The dog is released with the release signal "Okay" and a flick of the right hand, followed by the delivery of a food reward or play. Sit-stay is gradually introduced in the context of enhancing the attending response.

4. Gaze Orienting and Directional Cuing

As the dog orients to come, the trainer points directly over a treat or ball lying on the ground and then places the right hand over it as the dog approaches. The treat is given or

the ball tossed as the dog approaches the spot. Numerous variations are used to encourage the dog to make eye contact and follow gaze and other deictic (pointing) signals.

5. Parallel Orientation and Following

Food or toys can be hidden and the dog supported in its search efforts by periodically getting eye contact and then gazing, pointing, and walking in the direction of the cached item. Found rewards are conducive to significant surprise, and such interaction strongly supports following behavior and cooperation. Coordinated movements shaped with reward serve to integrate behavioral approach and social engagement while promoting cooperation, mutual appreciation, and interactive harmony.

The dog is encouraged to follow near the trainer's side by clicking and prompting it to sit with the right hand, saying "Good" as the dog begins to sit and delivering the treat and petting as the action is completed. The dog is released from the position with "Okay" and prompted to follow along or sent to chase a ball.

6. Dynamic Modal Activities and Play

Various play activities are introduced in accordance with the dog's ability to reciprocate. Intensive orienting/TAT (squeak), cortical reward (click-flick-surprise), attending (frontal orientation and eye contact), and following naturally promote dynamic modal activities and play. The emergence of play during social engagement therapy is an extremely valuable asset in the treatment of behavior problems. Training a dog to play tug, fetch, and catch games can promote joy and enhanced bonding. Retrieve games can be also be used to promote valuable go/no-go inhibitory conditioning effects and to encourage recall habits. Play adds complexity and refinement to the attentional nexus and improves a dog's ability to synchronize behavioral sequences so that they stay in temporal register with the behavioral sequences of the co-player. Competitive play activities, such as tug-and-fetch games, appear to fuse attention onto a point of common interest that promotes friendly exchange, rather than contest, via the differentiation of distinct roles that are equally necessary to initiate and continue the activity. Play continues only so long as it is rewarding for both players—a criterion that serves to promote mutual appreciation (empathy) and fair play, since to take advantage of the other or to neglect the other's needs might result in a loss of play momentum and cause the activity to grind to a halt. Nothing is more revealing of human character and canine temperament than their respective abilities and styles of play. Dogs exhibiting behavior problems invariably exhibit disturbances in their ability to play.

Many features of ball play recommend its use when organizing an adaptive coping style and cooperation. Russell (1936) long ago recognized the value of ball play for organizing adaptive behavior, listing six characteristics of special importance (paraphrased):

1. Chasing a ball involves the whole dog in relation to an object-activity outside of itself.
2. The dog's activity is attentively focused and coordinated with the course of action being pursued.
3. The activity is directed toward a particular goal, that is, picking up and returning with the ball.
4. The goal-directed activity shows a persistence of purpose as evidenced by the dog's willingness to search repeatedly over likely ground for a misplaced ball.
5. The activity is governed by the result produced by it; if the ball is not found, the searching sequence continues for a variable period or until the ball is found, whereupon the search stops.
6. The activity shows evidence of social cooperation and adaptive flexibility, as indicated by the dog's ability to shift from an unproductive search to turn to the trainer for help to find a misplaced ball.

Ball play mediates an intensely focused orientation on an object that the dog would wish to possess but must relinquish to produce the activity that engenders the object with its reward value. Likewise, the trainer shares an interest in the ball as a means to

control the dog's searching and retrieving behavior, entailing that the ball be received and thrown to generate the object-activity valued by the dog. As a result, the dog obtains the object-activity that it graves but sacrifices control of the object to the trainer to maintain the mutually rewarding exchange. For the ball game to continue, both the dog and trainer must give and take advantages with respect to the ball. If the dog grabs the ball and runs off with it, the object of interest is obtained, but the activity that makes it interesting is lost. The ball can be kept in play only by compromise and cooperation in accord with a principle of fairness. As a result of the give-and-take nature of ball play, a sense of fair play and trust (i.e., comfort with social uncertainty) appears to emerge. Tug games integrated into the ball game exemplify the competitive and possessive conflict underlying the activity, that is, the necessity of giving up the object in order to get the valued activity. The relinquishment of the ball to the trainer represents a submissive act of trust based on a belief that the trainer won't selfishly walk off with the object, but will toss it again, thereby meeting the obligation incurred by *accepting* the dog's trust (taking another's trust always involves obligations and responsibilities) and proving oneself as a leader fit to follow. The chase-and-retrieve sequences reflect a cooperative resolution of competitive conflict via the mutual reward resulting from sharing, fair play, and compromise. In contrast, a dog that gets the ball and runs off with it primarily obtains reward via the gratification of selfish and possessive interests stimulated by the owner's pleading for the ball (submissive begging) or by evading attempts by the owner to chase it down, thereby promoting competitive exchanges with little hope for a cooperative resolution. Such play results in interactive conflict, whereby reward is obtained by depriving the other of reward; that is, either the dog or the owner will win or lose. Whatever the outcome, the victory is achieved at the expense of the other and the integration of conflictive tensions and distrust. Under the influence of social attraction mediated by play, such unfair advantages promote social ambivalence by evoking frustration and anger. In the context of cynopraxic theory, tug and ball play, when performed in accord with a principle of fairness and compromise, mediates mutual appreciation (i.e., an attentiveness and responsive to the emotions and covert intent of the play partner) and trust, key transitions in the process of promoting interactive harmony and the integration of a friendly bond.

Finally, in addition to orienting/TAT and play, petting helps to promote a physiological state incompatible with both aggression and fear, providing a viable strategy for decreasing sympathetic arousal in some reactive dogs. Along with play, social rewards (petting and praise) should be integrated into training activities as a major source of reward for all basic obedience work. Not only does petting provide a potent calming and bond-enhancing effect, but excessive reliance on food-related incentives may adversely impact social attachment and affection levels by persistently overshadowing social attraction. Seeking food serves a useful function in basic training and many behavior-therapy efforts, but ultimately appetitive-seeking behaviors should be subordinated to seeking for social acceptance and affirmation while forming an affectionate and playful bond. In dogs showing a deficiency of social attraction, excessive reliance on food rewards may produce a relationship based more on food-getting incentives than on social attraction—a very undesirable outcome. Food-getting incentives are not intrinsically incompatible with social attraction, but appetitive training alone does not necessarily facilitate social attraction. The widespread belief that social rewards do not possess reward value in the absence of primary reinforcement is an operant-conditioning myth contrary to a number of scientific studies (see *Tactile Stimulation and Adaptation* and *Taction and Posture-facilitated Relaxation* in Chapter 6). McIntire and Colley (1967) found that the performance of experienced working dogs (military scout dogs) and naive dogs learning new basic obedience skills (sit, down, come, stay, and heel) showed a reliable decrease in response-latency scores as the result of petting and increased response-latency scores when petting was withdrawn.

In a related study, the researchers found that dogs trained by means of directive control and compulsion in combination with food reinforcement showed increased response-latency scores when the food reward was withdrawn. Interestingly, with regard to the value of social rewards, if the food reward was replaced with petting, the extinction-related latency effects were avoided. Maintaining a balance between petting, play, and food rewards is particularly important in integrating an affectionate bond with puppies.

Insufficient social attraction and appreciation of tactile stimulation appears to play a significant role in the etiology of certain forms of canine intrafamilial aggression (see *Posture-facilitated Relaxation Training* in Chapter 7). Among human adolescents, massage therapy has been shown to reduce aggression, perhaps by decreasing dopamine levels while increasing serotonin activity (Field, 2002). The guided restraint and focused tactile stimulation produced by posture-facilitated relaxation (PFR) training can be use to induce a potent relaxation response in dogs (see *Taction and Posture-facilitated Relaxation* in Chapter 6). The combination of nonthreatening controls, prompts, postural shifts, and restraint serves to promote measured shifts in parasympathetic and sympathetic activation while facilitating autonomic attunement in association with the induction of enhanced comfort and safety. PFR training programs a regulated response correlated with a positive set of expectations in association with a loss of control and increasing vulnerability in association with physical restraint, postural shifting and pressure, and regional manipulations. Rhythmic massage and petting help to further refine the attunement process and set the stage for the dog to transition into a deep relaxation. Repetitive petting appears to exert an adaptogenic effect on HPA drive and may help to integrate antistress and antiaggression effects via the activation of the oxytocinergic system (see *Oxytocin-opioidergic Hypothesis* in Chapter 6). In addition to stimulating changes in major neurotransmitter systems, posture-facilitated relaxation with massage may promote beneficial effects on vagal tone. A dilute odor (e.g., chamomile, lavender, ylang-ylang, or orange) that has been repeatedly paired with posture- and touch-induced relaxation appears to promote arousal conducive to calming and social engagement, perhaps by promoting an ambience of safety and conditioned relaxation. The autonomic attunement mediated by PFR training is bidirectional, with both the person providing the relaxation training and the dog receiving it benefiting from the enhanced sympathovagal balance and calming brought about by the experience.

Quality-of-Life Matters

Survival Modes and Allostasis

In addition to providing modal direction to species-typical behavior and mediating epigenetic adaptations appropriate to age and survival needs, specialized phylogenetic survival modes (PSMs) appear to be conserved from the dog's evolutionary past and activated by changing social or environmental conditions. PSMs are expressed cyclically throughout the canine life cycle in a relatively orderly way in the process of coordinating biobehavioral adjustments conducive to adaptation and survival. Benign PSMs promote adjustments conducive to dynamic autonomic equilibrium (sympathovagal balance) and long-term survivability. According to the survival-mode hypothesis, epigenetically programmed survival modes are variably activated and deactivated by environmental changes determined to be better or worse than ordinary, as indexed by the activation and tone of the HPA system, autonomic attunement/misattunement, and the mobilization of allostasis, that is, the coordinated adjustments needed to maintain biological integrity and stability in the context of change (Wingfield, 2003). The activation of a PSM is variably intrusive and compelling, ranging from a condition of motivational transparency overlaying everyday activities (appetites and preferences) to intrusive motivational imperatives (modal drives) that cannot be ignored without enduring significant agitation or distress. Autonomic networks probably coordinate the expression of modal drives that subserve PSMs activated or deactivated in association with social

exchanges (attunement/misattunement), QOL shifts, and allostatic changes associated with the switching on and off of the HPA system. The PSM defines in advance the class of behavior that will produce reward; it also determines whether a particular outcome will be satisfying.

The survival-mode hypothesis postulates that adaptation is relative and dependent on an organism's ability to cope by staying in step with the PSMs active at any given moment via the organization of appropriate control modules and adaptive modal strategies. Since the survival mode appears to determine in advance the class of behavior and outcomes that will produce reward, the activated mode exerts a global organizing effect on behavior, giving it motivational direction via modal drive. By these means, *instinct* exerts a profound influence on behavior without usurping executive functions. In the context of modal shifting or switching, reactive or rigid (compulsive/impulsive) adjustments to changes in motivational direction promote autonomic imbalance and negative mood, whereas flexible adjustments in harmony with modal change promote autonomic balance and positive mood. From a human perspective, obtaining gratification in harmony with modal drive and PSMs might be akin to obtaining meaning and contentment from behavioral efforts, whereas gratification obtained in conflict with modal drive and PSMs might produce subjective feelings of ennui, meaninglessness, and despair. These observations emphasize the relative independence of the cognitive and emotional effects produced by gratification and reward. According to cynopraxic theory, adaptive success is achieved by maintaining a dynamically stable state (allostasis) in the process of integrating secure social and place attachments via the optimization of comfort and safety (security) and the mobilization of adaptive modal strategies that are in harmony with survival modes and drive.

The activation and deactivation of PSMs is the coordinated outcome of countless neural networks and neurotransmitter systems, but DA, 5-HT, and NE systems appear to play prominent roles in the process. The present hypothesis speculates that oxytocin and AVP act as cofactors or moderators of DA, 5-HT, and NE activity in the process of activating, modulating, and deactivating PSMs in response to social and environmental stressors. Under worse-than-ordinary conditions (adversity), DA, 5-HT, and NE systems may be configured into survival modes aimed at avoiding danger and harm (autoprotective or loner mode), causing a dog to respond with increased anxiety, irritability, impulsivity, and aversion in response to social novelty and sudden or unexpected change; whereas, under the influence of better-than-ordinary circumstances, neural activity and traffic may be rerouted to produce modal changes conducive to calming, social integration, invigorated autonomic tone, and an adaptive coping style.

5-HT is hypothesized to contribute to the maintenance of stability over time against which backdrop modal changes weave in and out of sync and phase. The stability of biobehavioral systems is expressed in the form of biological rhythms that give rise to consistent adjustments having a cyclical or waveform shape and regularity (e.g., sleep/wake cycles) and expressed in the daily patterns of activity and rest, vigilance and foraging, hunger and satiation, and social comfort seeking and giving, as well as in various functional and dysfunctional adjustments to social and environmental stressors. In coping with adverse conditions, the serotonergic system may undergo harmful modifications via allostatic load and overload, impairing its ability to maintain a condition of flexible stability over time, perhaps causing behavior to become increasingly rigid (compulsive or impulsive). The increased 5-HT_{2A}-receptor binding potential shown by dogs exhibiting impulsive aggression (Peremans et al., 2003) may represent the cumulative allostatic load resulting from the serotonergic management of stress adjustments stemming from chronic HPA or SAM hyperdrive.

PSMs integrated under the influence of optimal developmental conditions are behaviorally invigorative and unifying, switching on and off at appropriate times and durations to enhance behavioral adaptation. However, with dogs exposed to adverse developmental stress,

PSMs may become stress sensitized and reactive, turning on impetuously to minimal triggers or switching off sluggishly or remaining chronically active or inactive. The activation of flight-or-fight survival modes and drive by conditioned and unconditioned stimuli anticipating imminent harm is adaptive, but many reactive dogs appear to remain persistently aroused to a state of vigilant readiness under the influence of a dysfunctional flight-or-fight mode. The resulting reactive coping style and allostatic load/overload may severely impair a dog's ability to adjust competently to household stressors. Although dysfunctional survival modes may remain relatively quiescent under auspicious environmental conditions that place few demands on the dog, they may be activated in response to social conflict and stress or as the result of integrating the PSM into social behavior emerging epigenetically at the time of puberty and early adulthood. Functional PSMs that ordinarily mediate adaptive adjustments may become dysfunctional (hyperreactive or hyporeactive) as the result of developmental stress. Instead of mediating adaptive behavior, the dysfunctional PSMs may be variably modified and integrated into a persistent state of sympathovagal imbalance producing a vulnerability to express generalized anxiety, depression, impulsivity, compulsivity, hyperactivity, separation distress, and aggressive reactivity. Under conditions of social ambivalence and entrapment, the dysfunctional PSM may lower reactive thresholds and predispose the dog to panicogenic impulsive or reactive aggression and numerous other adjustment problems. Once toggled on by stress or epigenetic triggers, the dysfunctional PSM may profoundly disrupt normal processing and impair the dog's ability to toggle off the malignant PSM. As a result, the dysfunctional mode may become progressively autonomous, perseverant or cyclic, and maladaptive in the process of degrading or abolishing executive control and fostering a reactive state of autonomic instability.

Quality-of-Life Index

Among dogs, the activation of survival modes is indexed by the release of circulating hormones and the activation of modal drives giving motivational direction to behavior. These chemical signals are hypothesized to configure into molecular keys that switch on and off potent PSMs affecting mood and behavior, including courtship, pair bonding, reproduction, social organization, maternal care, and territorial behavior. In addition to PSMs regulating the expression sex-related behaviors, survival modes are expressed in association with the release of chemical signals indexing stress-related changes. The diversified functions of AVP and oxytocin are consistent with the routing of modal shifts conducive to social integration or a loner-dispersal strategy (see *Diet Change and the Integrate-or-Disperse Hypothesis* in Chapter 7).

According to the integrate-or-disperse hypothesis, oxytocin facilitates social bonding, integration, and calming under the influence of environments perceived as safe and biologically optimal (adaptogenic), whereas, under the influence of environments perceived as unsafe or biologically suboptimal (stressogenic), AVP/CRF may cause the SES to retract and to promote dispersal and entrapment tensions, agitation, irritability, intolerance, and withdrawal (depression). Under the influence of social and environmental stressors that stimulate increased SAM activity, the HPA-system activity of susceptible dogs may be cranked up into a state of HPA hyperdrive, thereby mobilizing an allostatic state conducive to a reactive coping style that may be expressed in association with a defensive autoprotective mode or a defeat mode, depending on the allostatic vulnerabilities and traits expressed by the dog. The defeat mode promotes generalized anxiety, impassivity, and social withdrawal, whereas the autoprotective mode is associated with heightened anticipatory anxiety, sensory vigilance, and reactive readiness. By contrast, in addition to promoting antistress and calming effects via the activation of the flirt-and-forbear antistress system, oxytocinergic-opioid interactions with other neuropeptides and neurotransmitters may configure an intricate neuroregulatory network that promotes allostatic normodrive, social engagement, play and activity success, and modal strategies

conducive to the organization of an adaptive coping style.

A dog's ability to integrate harmonic relations with people and other dogs inside and outside of the home depends on the presence of secure social and place attachments. The quality of social attachments is positively correlated with a variety of QOL factors, including diet, exercise, somatic and cortical reward, perceived safety, play, freedom of movement, exploration, and access to diverse social and place experiences. A high QOL index is hypothesized to promote social attraction and drive consistent with secure attachments and play, whereas a low QOL index tends to promote social repulsion and withdrawal, dispersive tensions, and autoprotectiveness. According to the integrate-or-disperse hypothesis, moving from an adequate QOL index to a higher QOL index tends to promote tolerance for social novelty and sudden change, but only insofar as QOL enhancements are linked with an increase in affiliative exchange. Improving a dog's diet or increasing exercise (e.g., putting the dog outdoors) without simultaneously increasing positive social interaction [e.g., tactile stimulation (petting and massage), socialization, and reward-based training activities] may increase its vulnerability for reactive behavior in response to social novelty and unexpected change. In contrast, dogs transitioned from an adequate QOL index to a suboptimal QOL index may respond in an opposite way to increased proxemic exchange (e.g., close contact, handling, and tactile stimulation) by showing signs of social avoidance and withdrawal or decreased exploration of novel situations. Augmenting a dog's QOL index without supplemental social interaction and training or degrading its QOL while simultaneously increasing demands for exchanges with unfamiliar persons or exploring novel environment and things may promote counterproductive autonomic misattunement dynamics (see *Diet Change and the Integrate-or-Disperse Hypothesis* in Chapter 7).

Cynopraxic training procedures typically embody both QOL enhancements and intensified social exchange with the goal of promoting mutual appreciation and interactive harmony. As such, play is an ideal cynopraxic procedure because it incorporates QOL enhancements associated with physical exercise and the activation of a variety of drive systems while simultaneously increasing the quantity and variety of affiliative exchanges. As such, increased social and object play should promote enhanced responsiveness to social novelty and sudden change, whereas decreased social play appears to increase the risk of reactive arousal to ambiguous or uncertain social exchanges between the dog and the nervous or insecure attachment object and increase latency or reduce the amount of exploratory behavior in response to novel objects or places. An opposite set of effects should flow from training procedures that systematically decrease social and appetitive stimulation (withholding of affectionate interaction, play, food, tactile stimulation, and access to toys) while increasing social isolation, physical restraint, and confinement—practices that are generally referred to as emotional and deprivational abuse by the pediatric community (Golden et al., 2003) but are commonly used as therapy to treat canine separation-distress and dominance-aggression problems on the basis of compelling the dog to detach or coerce a change of attitude with respect to perceived social rank by compelling detachment from insecure social and place attachments. Such procedures seem counterintuitive and contrary to the basic tenets and goals of cynopraxis. In the case of dogs showing intrafamilial autoprotective aggression in association with unfairness and incompetence and a loss of trust, the use of social, emotional, and appetitive deprivation procedures should only increase social ambivalence, dispersive tensions, and entrapment dynamics in the process of elevating the dog's irritability and reactivity in response to ambiguous social exchanges. These collective changes in response to deprivational establishing operations may actually increase the risk of impulsive aggression rather than helping to reduce it. Attempting to coerce an indulgently dependent and reactively incompetent dog into submission by abruptly extracting insecure attachment relations or refusing access to attachment objects and places associated with

comfort and safety may only serve to exchange dependency by indulgence for dependency by domination; nothing has essentially changed, except that the interaction has now become dramatically more volatile and imbalanced in an opposite direction.

Environmental improvements and degradations affecting a dog's QOL appear to mobilize distinct survival modes conducive to enhanced social integration or dispersal (entrapment). Social interaction incompatible with the educed mode appears to result in social anxiety and aversion. This general hypothesis is central to cynopraxic theory, whereby interactive changes conducive to enhanced bonding are coordinated with environmental changes conducive to an improved QOL, thereby simultaneously integrating secure social and place attachments while promoting autonomic attunement (calming), social bonding and trust, and emotional and drive propensities (i.e., affectionate playfulness) incompatible with aggression. Attempting to improve interaction and integrating consistent, fair, and structured interaction via ICT without simultaneously improving a dog's QOL is problematic and may only increase insecure attachments or serve to activate autoprotective dispersal/loner tensions, whereas improving a dog's QOL without integrating social interaction and affiliation based on a principle of fairness may actually heighten social insecurity and dependency rather than helping to reduce it. Even slight modifications of diet may exert pronounced changes in a dog's social behavior (see *Fat, Cholesterol, Fatty Acids, and Impulsive Aggression* in Chapter 7). For example, supplementing the diet with fat or polyunsaturated fatty acids (PUFAs), especially omega-3 [eicosapentanoic acid (EPA) and docosahexanoic acid (DHA)] may enhance a dog's ability to cope with emotional stressors and reduce impulsive behavior, perhaps via the improvement of serotonergic transmission (Buydens-Branchey et al., 2000). However, McCreary and Handley (2000) could not produce any change in 5-HT_{1A}- or 5-HT_{2A}-mediated behaviors in rats treated with a cholesterol-reducing drug for nearly 2 months, suggesting that the adverse effects of low cholesterol on stress-related behavior and impulsivity may be mediated by another system. Another possible target of omega-3 therapy may be stress-related proinflammatory cytokines that are produced in association with allostatic hypodrive and linked with depression and irritability. A recent report lends some support to the hypothesis that low cholesterol levels (hypocholesterolemia) may play a role in the etiology of certain forms of autoprotective impulsive and reactive aggression. The researchers found that dogs diagnosed with dominance aggression showed low total cholesterol, low serum triglycerides, and low high-density lipoprotein cholesterol (HDL-C) in comparison with nonaggressive controls (Penturk and Yalcin, 2003).

In addition to dietary and social considerations, QOL enhancements should focus on exercise, play, grooming, activity success and freedom of movement, and varied environmental activities contributing to a state of canine well-being. Recording the amount of time that a dog spends crated or otherwise socially isolated during the day and night provides a useful QOL and social attachment indicator. Excessive crate or outdoor confinement is contrary to cynopraxic goals and typically points to significant interactive conflict and dispersive tensions between a dog and household. Cynopraxic training and QOL improvements are organized to address these disruptive influences comprehensively.

Opening the Training Space

In comparison with animals trained under the constraints of the laboratory, a typical family dog is exposed to a far greater diversity of arousing stimuli, extraneous reinforcement opportunities, and adjustment demands, some of which are potentially harmful to it or to others with whom the dog comes into contact. Unable to restrict a dog's access to these opportunities or to block entirely the undesirable behaviors that dogs are apt to show, cynopraxic trainers are compelled to construct a behavioral analogue to the physical restrictions and controls found in the laboratory setting via the agency of inhibitory conditioning

(McIntire, 1968). Establishing inhibitory control is particularly important for dogs exhibiting attention and impulse-control deficiencies affecting their ability to accept social limits, to delay gratification, to regulate emotion, and to control aggressive behavior. To address such issues properly, a training space is configured at three points of interaction: pulling, jumping up, and biting. The training space is established to provide a social context of interaction conducive to reward-based training and play.

The first step in this critical process focuses on the inhibition of pulling into the leash. Instead of physically holding the dog back and causing it to strain into the leash, the impulsive dog learns to regulate its behavior within the limits set by the leash in the context of controlled and slack-leash walking. Deliberately allowing such dogs to pull into a dead leash is misguided and potentially harmful (see *Walking on Leash* in Chapter 1). Not only is the persistence and novelty seeking of such dogs virtually inexhaustible, the frustration produced by such efforts will only cause impulsive dogs to pull harder in the process of activating and conditioning oppositional reflexes. Although the passive restraint afforded by a muzzle-clamping halter may be more effective and less prone to the foregoing effects, such restraint is not without significant potential problems. Impulsive dogs often show considerable arousal and distress when first exposed to halter restraint. Many of these dogs struggle persistently and violently to escape by scraping at the halter with the front paws; by twisting, flailing about, falling down to rub their head against the ground; or by pulling back and shaking their head violently back and forth in an effort to break free of the collar (see *Aggressive Barking, Lunging, and Chasing*). The latter maneuver, however, results in a severe and persistent clamping action across the muzzle. After repeated exposures of this kind, the dog may finally recognize that its efforts to escape are futile and simply give up, appearing to adopt an attitude of resignation and surrender to the owner's domination. Halter training of this sort does not appear to translate into avoidance and inhibitory conditioning of the sort needed to facilitate improved attention, impulse control, and autonomic regulation. As a result of such mishandling and improper exposure to halter restraint, the dog, discovering that the aversive restraint is inescapable, may move from an active state of hyperarousal into a passive state of behavioral inhibition and hypoarousal resembling learned helplessness—and both states reflect autonomic dysregulation but from opposite extremes.

Introducing dogs to halter restraint with a nonclamping halter in the context of reward-based training can mitigate many of these problems. The nonclamping halter is designed to prevent the clamping action that occurs when dogs attempt to back out of muzzle-clamping halters. When introducing the muzzle-type halter to impulsive or reactive dogs, it is most safely and humanely accomplished with two leashes: one attached to the muzzle-clamping loop and the other attached to a flat-buckle collar or limited-slip collar. The arrangement allows a dog gradually to accommodate the unfamiliar and potentially threatening feel of the halter-clamp action seizing its muzzle, thereby avoiding a potent aversive event that may needlessly link the device with fear, pain, and panic. First impressions are powerful and lasting, especially in the case of things that trigger threat arousal and sustained pain, or impose a condition of inescapable aversive stimulation, while simultaneously disabling a dog's primary means of defense and blocking its means to flee—psychologically nothing could be more traumatic for reactive dogs. A similar state of affairs and helplessness effects appear to ensue as the result of improper crate training, whereby a dog is forced into a condition of inescapable restraint and social isolation, and then left to cope with escalating separation distress and emotional dysregulation. In both cases, the novelty of the events and the loss of control over threatening situations result in intense and persistent sympathetic hyperarousal and finally activate the immobilization system (helplessness) as the stimulation is perceived as inescapable. Since crates and halters are readily available to novice owners with little or no significant instruction, great potential harm is done to impulsive or reactive dogs by such instruments of restraint. It is distressing to consider the miserable state of a young energetic dog that spends 16 to 18 hours a

day *stored* in a crate barely big enough for it to lie down, and whose only respite from the drudgery and tyranny of such confinement is to be taken outdoors periodically on a muzzle-clamping halter to eliminate. As a result of these welfare concerns, pains are taken to introduce the crate and halter in uneventful stages and to use such mechanical suppressors of behavior in the least intrusive and minimally aversive ways necessary to achieve training objectives in a timely and humane manner and then to fade their use as these training goals are met.

Despite the potential for abuse and misuse, if properly introduced and used in the context of reward-based training, the muzzle-clamping halter can help to provide head and jaw control that makes handling aggressive dogs safer for both the trainer and others coming into the dog's vicinity. For dogs with a history of aggressive behavior toward visitors, the muzzle-type halter gives the handler an effective means to restrain a dog that might become aggressive unexpectedly during training. Consequently, despite valid concerns, the potential benefits of muzzle-clamping halters for managing and controlling aggressive dogs appear to outweigh the manageable risks. A reactive dog should be kept on a muzzling halter and leash or a muzzle for the sake of added head control and restraint, but other collars are typically selected for inhibitory training purposes. For example, the often-maligned and misused prong collar can be used to rapidly establish active limits on pulling excesses with little risk of harm to the dog, thereby opening a viable training space and allowing the trainer to focus more exclusively on other behavior-therapy objectives. Although giving the appearance of a medieval torture device, the prong collar is a sophisticated training device with a number of obvious and not-so-obvious features that make it extremely versatile and useful in the context of controlling highly motivated and impulsive behavior and in developing effective go/no-go and all-stop inhibitory control.

Inhibitory Conditioning

The selection of a training collar and the techniques used for inhibitory training is guided by a dog's particular temperament, sensitivity, history of training, and its owner's ability and commitment to learn the skills necessary to use the equipment properly (see *Training Tools* in Chapter 1). A tool of considerable value in this regard is the limited-action slip collar with or without a fixed-action halter. This training collar gives skilled trainers the means to deliver a precise level of stimulation, ranging from gentle pulsing and directive prompts to a *dead-halt saccade*. The term *saccade* is borrowed from horse training and refers to a sharp action applied to the reins. The word also refers to the sudden and forceful movement of a violin bow that causes the sound of two or more strings being struck sharply at once. In any case, the function of the saccadic prompt is to inhibit impulsive behavior rapidly without inducing disorganizing anxiety and fear. The saccade is always associated with an abrupt release of leash slack immediately before stepping back and anchoring the leash with both hands in front of the torso, just above the center of gravity, before shifting back and tensing as the dog hits the end of the leash. The sequence establishes a close forward association between the release of leash slack and the saccadic event. Yanking against a taut (dead) leash is not a saccade, and such uses of the leash should be avoided. Allowing a dog to pull into a dead leash is virtually always counterproductive and indicative of incompetent dog-handling skills. The saccade is followed by vocal reassurance and sustained petting around the underside of the neck and continues widely over the dog's body, followed by massage on the back of neck and shoulders to further facilitate calming and autonomic attunement. The saccade often produces a one-trial learning effect, whereby the dog learns to rapidly stop whatever it is doing at the moment the leash slack is dropped (all-stop response) or to turn its attention toward the trainer (stop-change response), thereby reentering the training space.

The directive saccade reduces stress while establishing inhibitory control and entraining parasympathetic tone incompatible with reactive arousal. The systematic entrainment of parasympathetic tone while mediating an adaptive coping style promotes emotional

states incompatible with impulsive and reactive adjustments. The autonomic effects mediated by directive training are key to understanding how such procedures help to increase the confidence of shy dogs and reduce the aggressiveness of bold dogs. Contrary to erudite opinion to the otherwise, such procedures do, in fact, promote beneficial change and do so without increasing reactive emotion or behavior. However, aversive events that lack predictability or controllability are stressful to dogs and should be avoided. Inhibitory training is typically carried out with the dog outdoors while it is engaged in energetic and non-specific seeking of drive-activating stimulation.

The changes in parasympathetic tone by means of leash prompts and saccades may be mediated by pressure stimulation of arterial baroreceptors located in a dog's neck. When placed correctly on the neck, the training collar closes over the carotid sinus, the brief compression of which may result in the generation of an electrical signal that causes the heart to slow down (Seagard et al., 1999). Afferent vagal signals also leave the heart and communicate the change in cardiac rhythm to the brainstem, which may in turn activate cortical and limbic regulatory centers in the process of tuning sympathovagal state arousal to enable the dog to cope proactively with the abrupt and surprising change. Although changes in heart rate following carotid stimulation quickly abort, the afferent vagal signals returning to the brain may shift autonomic balance to match the physiological requirements needed to facilitate improved orienting, maintain the all-stop response, or promote sustained attention—changes that are often directly reflected in a general calming and improved attention and impulse control that immediately follow such training events. According to cynopraxic training theory, the directive prompt evokes an emotional establishing operation conducive to the expression of behavior that enabled the dog to control similar events successfully in the past.

The autonomic changes produced by the directive event are associatively linked with various antecedent stimuli (e.g., dropping the leash slack, smooch sound, and all-stop signals) that are arranged to occur immediately prior to the directive prompt or saccade. As a result, these conditioned stimuli acquire the capacity to shift parasympathetic tone in the absence of the unconditioned vagal reflex evoked by the leash prompt. The petting and vocal comforting that follow directive events may amplify or sustain vagal tone and actively oppose sympathetic activation, thereby helping to promote sustained attention and calmness. The power of traditional dog-training techniques to calm overly reactive and impulsive dogs appears to be related to these potent and complementary effects of the directive leash prompt and tactile stimulation for tuning sympathovagal tone. As such, the leash prompt is a corrective event insofar as it *corrects* autonomic tone that facilitates reactive behavior. The combination of leash prompting followed by petting and praise serves to facilitate autonomic tone conducive to adaptive behavior, calming, and a secure *connection* mediated by autonomic attunement. Dogs appear to have evolved an autonomic nervous system designed to cope with such training, exhibiting significantly increased parasympathetic tone than found in humans (Little et al., 1999) and wild canids (Fox, 1978). The brief pressure of a leash prompt stimulating baroreceptors located in the carotid sinus appears to produce a significant parasympathetic response while promoting enhanced attention and impulse control, whereas steady pulling (horizontal hanging) or forceful yanking into a dead leash appears to agitate the dog and to further disturb executive control functions.

An impulsive dog is generally walked in a controlled position at the handler's left side, with the dog's hip aligned with the handler's left leg. The handler holds the leash in the left hand as described in Chapter 1 (see *Leash Handling*). The dog is prompted to orient while on leash with a smooch or squeak sound and later with its name. As the dog gives a flinch alert to the orienting signal, a click is delivered, followed by a right-handed flick and delivery of the reward by tossing it to the dog. The reward is given to the dog while the trainer maintains forward movement or after stopping and prompting a sit

response. If the dog becomes distracted or moves out of position, the orienting signal is given, an abrupt stop or right turn-away from the distraction is performed, or the dog is prompted back into the proper starting position (see *Walking on Leash* in Chapter 1), as required by the circumstances. The standard reward is periodically interspersed with a highly valued food reward (surprise) and petting. Surprises are frequently timed to occur in association with antecedent praise and petting. In addition to varying the size and type of the reward, sustained rewards with several small treats can be highly effective, especially with respect to shaping introductory attention (eye contact) and stay training. Surprise can also be generated by the introduction of periodic bouts of ball play or other forms of play as appropriate for a particular dog. Go/no-go inhibitory training can be effectively introduced in the context of periodically saying "Wait," stopping, and prompting the dog to stop with a wave of the right hand and gentle leash prompting if necessary before continuing on. Go/no-go training can be mastered at the door before going for a walk, before coming inside after a walk, before going up and down steps, before allowing a dog to take its meals, and on numerous other situations in a manner consistent with ICT. Go/no-go countermand signals can also be developed in the context of ball play. Once a strong ball drive and routine are established, the dog can be taught to delay gratification and wait (no-go) before it is prompted to chase the ball. "Wait" functions as a cancellation signal countermanding the impulse to chase the ball while imposing a no-go condition that eventually results in the reinstatement of the original impulse via the go signal "Take it," releasing the dog to fetch the ball.

Counterconditioning: Limitations and Precautions

When performed by skilled trainers, appetitive counterconditioning, reward-based training, and play can integrate a significant amount of behavioral control, but only within the context of a reliable training space formed by setting limits on reactive/impulsive behaviors. Typically, the modification of impulsive behavior incorporates a combination of strategies, depending on its severity, including preemptive prompts (e.g., diverters and disrupters), stop-change conditioning (e.g., orienting/TAT), go/no-go (e.g., "Wait"), all-stop conditioning, and intensive basic training. All of these elements are critical for establishing a viable platform for graduated counterconditioning within the home environment. Technically, counterconditioning is a classical conditioning procedure, but, in practice, classical and instrumental procedures are inextricably intertwined and wedded. An effective counterconditioning stimulus not only serves to evoke emotional arousal incompatible with reactive emotional conflict, but it may also reinforce instrumental behavior incompatible with aggressive behavior. Generally, counterconditioning procedures are useful in three ways, reflecting the complementary effects of classical and instrumental conditioning: (1) counterconditioning stimuli elicit appetitive and emotional responses that are incompatible with or overshadow competing negative reactions elicited by the target, (2) counterconditioning stimuli (e.g., food, taction, and play) can function as appetitive and emotional establishing operations, and (3) counterconditioning stimuli can be used as rewards to shape prosocial behavior.

Pavlov (1928) tested the efficacy of graduated exposure, appetitive counterconditioning, and instrumental training for controlling reactive guarding behavior in dogs housed under laboratory conditions. The two dogs treated by Pavlov showed reactive aggression toward any person, other then the experimenter, who approached them while they were restrained in an experimental harness. When out of the harness and walking freely about the experimental room, the dogs tolerated the approach of strangers. When away from the experimental setting, the dogs were friendly and showed no signs of aggressive behavior. At such times, they showed a social indifference toward the experimenter and would allow others to approach and even strike the experimenter without showing any sign of resentment toward the action. Interestingly, Pavlov found that the level of aggression

exhibited by the dogs was strongly influenced by the character of the experimenter. When in the company of an experimenter who displayed a commanding control style with positive and negative aspects, the dogs showed a significant increase in aggression toward people entering the experimental room in comparison to the aggression levels shown when the dogs were in the company of a more reserved experimenter who displayed a more circumspect control style. In the latter case, strangers could enter the room without evoking aggression, so long as they did not make any sudden movements, whereas, in the former case, the dogs were stimulated into a "furious rage" when approached.

The different control styles exhibited by the two experimenters described by Pavlov is consistent with the low-power and high-power autonomic/cognitive profiles described by Bugental and colleagues (1993 and 1997). The increased aggressive reactivity while restrained in company with the reactive experimenter may be due to autonomic changes resulting from inescapable exchanges with an emotionally labile (low power) and ambivalent attachment object, whereas the reduced aggressive reactivity expressed while entrapped with the reserved experimenter may reflect the autonomic effects of inescapable exchanges with an emotionally stable (high power) and ambivalent attachment object—findings that may be of significant value for evaluating the effects of person on intrafamilial and extrafamilial aggression. In short, the highly specific nature of the provoking situation (restraint in an experimental harness) suggests the possibility that the inescapable exchanges with the two experimenters served to differentially modulate the aggressive reactivity shown by the dogs via different stimulatory on autonomic tone. These observations raise the possibility that entrapment with an ambivalent attachment object may facilitate the expression of different types of extrafamilial aggression, dependent on their control style and autonomic tone, perhaps giving clues to the etiology of dogs that express habituating versus nonhabituating watchdog scripts.

Pavlov tested two counterconditioning procedures for potential efficacy in reducing the reactive guarding behavior of these dogs. One procedure used appetitive counterconditioning to condition stimuli emanating from his person (e.g., shape, odor, and voice) with food to cause his presence to evoke arousal incompatible with aggression. A second dog was trained in similar fashion with the addition of an instrumental response not trained in the first dog. The training process was performed by Pavlov himself and lasted for 2 months, concluding with several days of testing to evaluate the effects of the procedures. Training was initiated by feeding the dogs by hand in a minimally provocative situation, the main hall, where both dogs were friendly with people. Feeding by hand was performed to bring the scent of the experimenter into the composite conditioned stimulus (CS). One of the dogs, Usatch, was trained to respond to the word "sausage." Conditioning was performed by saying "Sausage, Usatch," and then reaching into a pocket, removing a glass case, opening the case, and selecting a piece of food that was delivered by hand or dropped on the floor. Next, Pavlov developed a discrimination procedure, whereby he stood among a group of people before calling to the dog and rewarding him. To foster contextual generalization, the dogs were called from unusual locations with a variable tone of voice, thereby invigorating the auditory component of the composite CS. The second dog, Calm, was given similar training, except that he was required to sit and to give a paw with the command "Sit down; give your paw" before obtaining the food reward.

Contrary to anticipated results, the restrained dog launched into a fierce attack mode as the trainer entered the room, just as it had done with any stranger entering the room in the past. Counterconditioning by pairing food with the person CS proved inadequate and failed to compete with aggressive arousal. Additional control (e.g., interrupting the barking response) was evoked by commanding Calm to sit and to give its paw or by calling Usatch by name, but the strength of these CSs and command components to restrain aggressive arousal were fragile and rapidly diminished as the trainer attempted to approach closer to the dog and experimenter,

whereupon the dog again became aggressive. However, if the trainer reached into the pocket usually containing food, the dog could be persuaded to allow a slight additional advance, followed by more if the trainer withdrew the *empty* glass container previously associated with food. A full approach to Calm could be achieved only by showing the dog the glass case containing food as the trainer moved forward. If the dog was fed from the trainer's hand, it allowed him to threaten and to strike the experimenter lightly, actions that would have previously led to uninhibited attack.

Pavlov's investigation appears to draw into question the viability of counterconditioning and sit-stay training as stand-alone procedures in the treatment of aggression problems. The study strongly recommends that these procedures, as used in many contemporary applied animal behavior systems, should receive experimental and controlled clinical investigation for efficacy. Despite their widespread use and virtually unquestioned acceptance, neither procedure has been proven to reduce aggression. Although counterconditioning may palliate or antagonize the arousal elicited by aversive stimuli and facilitate the disconfirmation of previously acquired conditioned threat expectancies, preattentive biases in association with trait anger and anxiety may nevertheless persist or be rapidly reinstated despite the most conscientious counterconditioning efforts. The acquisition of food may momentarily quell aggressive arousal, but the nonfamilial status of a visitor may persistently evoke distrust, suspicion, and potential for animosity. Dogs expressing a rigid watchdog script may be genetically programmed to resist counterconditioning effects actively (see *Flexible versus Rigid Watchdog Scripts*). Counterconditioning applied to reduce state anxiety associated with extrafamilial aggression may rapidly decrease signs of defensive behavior but may not reduce the dog's distrust or propensity for offensive behavior, operating under the motivational influence of trait anxiety and anger. Problematically, state anxiety and anger (agitation) associated with reactive conflict appear to be more rapidly decreased with counterconditioning than are trait-anger propensities causing the dog to confront the intruding stranger. Further, the mere reduction in agitation does not automatically increase social attraction and the dog's ability to integrate friendly relations with a visitor. Furthermore, despite the reduction in overt reactive behavior, conditioned autonomic responses may persist or worsen over time via schizokinetic and autokinetic mechanisms (Gantt, 1944; Dykman and Gantt, 1997). As a result, even though a dog appears to be more relaxed, it may still remain under the influence of an unstable sympathovagal equilibrium that can unexpectedly shift and trigger aggressive behavior.

Many reactive and impulsive dogs appear to be affected by disturbances of their ability to engage and disengage attentional resources and to shift flexibly in and out of motivational states necessary to explore and habituate competently to novelty, learn to relax in the presence of unfamiliar persons and places, and respond in a neutral or positively biased way to unexpected or sudden changes. These deficits appear to develop in association with chronic defensive arousal (anticipatory anxiety) and stress. The allostatic load associated with being constantly on guard and at the ready for the worse to occur may result in the disengagement of critical social and attentional resources that are needed to regulate and attune autonomic tone to changing circumstances, perhaps causing the dog to rely on subcortical systems for the processing of social novelty and for mediating autonomic adjustments via the activation of the flight-fight system. Consistent with such a hypothesis, extrafamilial aggressors often show a persistent inability to habituate and relax. Overly vigilant and reactive dogs cannot disengage attention from the novel aspects of an unfamiliar person to turn attention toward more positive and familiar associations that might serve to activate the social engagement system—a system that remains inactive so long as the dog remains apprehensive. In the absence of active social attraction, the persistent vigilance exhibited by such dogs is shadowed by a preemptive readiness to attack (see *Collicular-Periaqueductal Gray Pathways and Reactive Adjustments*). Bottom line, despite

the most dedicated counterconditioning efforts, aggressive dogs may continue to harbor a negative bias toward nonfamilial persons and respond to them as potential threats.

A related stumbling block impeding the effectiveness of counterconditioning is associated with the timing of incompatible appetitive stimuli. Aggressive arousal elicited prior to the presentation of the orienting stimulus or incompatible diverter (e.g., food, petting, or play) may shield sensorimotor gating, orienting responses, and aggressive intention movements against beneficial counterconditioning effects. The key to avoiding such problems is to evoke preemptive establishing operations, establish effective orienting and attention control, and develop reliable instrumental control. Targeting preattentive processing and the preemptive emotional arousal resulting from it figures prominently in integrating an adaptive coping style and reducing reactive behavior. However, habitually presenting diverters and disrupters after a dog has already reached the point of showing overt agonistic intent is contrary to effective behavior therapy. Orienting/TAT appears to be useful for limiting the adverse effects of reactive preattentive processing and, together with inhibitory conditioning, should be an important part of preliminary training efforts. Essentially, the conditioned target-arc stimulus (e.g., squeak, smooch, or whistle) serves to establish preemptive processing and arousal incompatible with aversion, making it easier to integrate more positive associations.

PRECAUTIONS FOR SAFER CONTACT

Working with dogs that show an established propensity for extrafamilial aggression requires that the counselor-trainer take appropriate precautions to minimize risk of personal injury. Since such aggressive behavior occurs under the influence of territorial incentives and triggers, territorial aggressors are best initially approached away from the home. Approaching a dog that is sensitive and reactive to territorial intrusion by directly entering the house is a very risky practice that should be avoided for several reasons. Not only is the trainer vulnerable to an attack if the owner loses control of the dog, but it is likely that a lasting negative impression will be produced, further reinforcing adverse expectations associated with the arrival of guests and making future training efforts more difficult. First impressions for dogs (and owners) are influential and lasting. In addition to optimizing first impressions and reducing the risk of precipitating an aggressive episode, the gradual approach allows the trainer to perform a variety of procedural probes and tension-reducing procedures to evaluate safely the dog's level of reactivity and to initiate a pattern of interaction conducive to acceptance by the dog. The trainer should mentally rehearse a plan of control or escape if the owner fails to follow instructions or loses control of the dog. Although one should prepare for the unexpected and possess the means and skills to defend oneself against attack and minimize any resulting injuries, mastery is primarily concerned with the acquisition of skills and knowledge to avoid such situations in the first place. The risk of serious attack is an occupational hazard of professional dog training that cannot be entirely prevented; nevertheless, much can be done toward preventing bite-related injuries by taking common-sense precautions, exercising appropriate respect toward the dog, minimizing the use of confrontational procedures, heeding the wisdom of fear, and learning from past mistakes.

The procedure for approaching dogs showing aggression toward strangers and visitors involves several steps. The owner is instructed in advance to have the dog on leash with a slip collar attached in tandem with a muzzle-clamping halter, as appropriate for safety. Instead of directly entering the house, the trainer should knock at the door and walk away from the house while laying a trail of treats dropped at varying distances. The sole of one shoe can be smeared with a small amount of a fragrant odor (e.g., orange, lavender, or chamomile), thereby forming a scented link between the treats. The selected odor can also be put inside a squeaker and dispensed just before tossing the dog a treat. The owner is instructed to direct the dog's

attention to the treats or to pick them up by hand and feed them to the dog. During this introductory phase, the dog should be kept at a safe distance, approximately 10 to 15 feet behind the trainer. Going for a walk is a rewarding activity for most dogs that is made even more so by finding easy treats along the way. As the walk proceeds, the trainer can step off to the side and allow the owner and dog to pass by, and then follow them from behind at a nonthreatening distance. Throughout the process, the trainer and owner should converse, with the owner periodically calling the dog by name, prompting it to sit (if previously trained to do so), and rewarding nonthreatening behavior with affection and treats. The trainer gradually moves in closer, calls the dog's name, uses the squeaker, and tosses the dog a treat. For dogs that remain defensive, the trainer can walk out in front and drop a few more treats for the dog to find. Periodically, the trainer should stop and let the owner and dog pass by, before walking in the opposite direction and signaling the owner to turn and follow along from behind. The approach, follow, and turn procedure is repeated several times. Throughout the process, the owner and trainer should maintain a friendly dialogue.

As the dog's willingness to accept the trainer's presence improves, the trainer can take the leash in hand. With large or potentially dangerous dogs, the trainer can take control of a second leash. The two-leash arrangement provides added control and safety, but should not be used for the sake of gaining an advantage from which to punish the dog. Although the equipment can be effectively used to restrain the dog, if needed to prevent or block an attack, no significant advantage is achieved by punishing a dog while it is restrained or muzzled. The idea is to use the added safety and control of the arrangement to foster trust and help the dog to learn that aggression is not necessary to control the situation. Although some dogs may become reactive as the trainer takes control of the leash, they are easier to calm and typically less aggressive than would be the case if approached or handled while inside the house. The outcome of the introductory process is typically peaceful and serves to provide a useful step toward establishing a working rapport with the dog and the owner. The owner should be encouraged to introduce guests and visiting dogs in a similar way or, at minimum, allow the dog to become familiar with the person before entering the house. The foregoing method of introduction allows the dog to interact away from reactive associations linked to the door. Taking a walk together may allow an outsider to become at least superficially accepted into the family group. During such introductions, the owner and the visitor can perform a number of friendly model/rival exchanges in association with a favorite toy or food item. The visitor is encouraged to toss treats rather than attempt to feed the dog by hand. Feeding a potentially aggressive dog by hand is dangerous and could result in a severe bite, especially at times when the dog is highly excited and distressed. Throughout the introduction and visit in the home, the dog should be appropriately restrained on leash and collar, halter, or muzzle, as needed to prevent an aggressive episode.

Aggressive Barking and Threats Toward Visitors

A complete history of aggressive episodes, including target, location, and severity, should be obtained. Extrafamilial aggression occurring in specific contexts with predictive threats is much more easily treated than is highly generalized or unpredictable aggression. Dogs involved in territorial attacks producing serious injuries should only be cautiously accepted for behavioral training. Similarly, dogs delivering bites unpredictably without warning are by definition untreatable (see *Control and Management of Behavior Problems versus Cure* in Volume 2, Chapter 2). The sorts of judgment needed to assess risks safely and provide appropriate behavioral training come from knowledge-based experience, and only the most knowledgeable and experienced trainers should work with dogs exhibiting extrafamilial aggression.

Dogs showing threats or aggressive behavior during greetings should receive intensive

basic and integrated compliance training focusing on attention, controlled walking, sit-stay, and down-stay modules and routines. The dog's training should be performed throughout the house, yard, and immediate neighborhood, but efforts should be especially focused and intensive around doorways and other territorial frames associated with aggressive arousal (e.g., windows, fence lines, and gates). The starting exercise should be practiced to a high degree of proficiency, with the dog going to the handler's left side without hesitation. The sit-stay routine should be trained to a high degree of reliability up to a 1-minute duration and down-stay up to a 10-minute duration. During the early phases of down-stay training, the handler should frequently return to the dog with rewards, gradually decreasing the reward frequency as the dog's ability to stay improves. The dog's greeting routine should be brought to a high degree of refinement via repeated rehearsal prior to using it in the context of behavior therapy and staging actual greetings with visitors. In addition to practicing the starting exercise and stay training, a quick-sit module should be brought to a high degree of proficiency and practiced under a variety of increasingly difficult conditions. The dog should sit rapidly and remain in the sit position. The training process should set clear limits on impulsive behavior within the context of reward-based training efforts, whereby the foregoing control modules and routines are shaped with food rewards, affection, play, and various everyday rewards (e.g., opportunities to go for a walk). In addition to basic training, PFR training should be performed in locations near doorways (see *Appendix C*). An odor is paired with the induction of relaxation and used during greetings to support social exposure and habituation efforts. Interactive play activities are initiated in association with ringing of the doorbell. Various pieces of equipment, treats, toys, and so forth, should be kept conveniently within reach near the door. A leash should be permanently kept looped over the door handle together with a sign on the door to remind family members not to open the door until the dog is properly restrained or confined.

In some cases involving persistent alarm or threat barking, a remote-activated doorbell can be installed, allowing the handler to activate the sound of the bell while rehearsing the greeting routine. Initially, the bell mechanism may need to be muffled to enable a more gradual exposure and counterconditioning process. Counterconditioning the dog's response to the bell is performed in different parts of the house and at variable times of day. The bell can be used to announce mealtimes and opportunities to go for a walk. Family members can ring the doorbell before entering the house and again as they leave. The combined effect of such conditioning is to integrate new associations with the sudden change associated with the sound of the bell, giving it a broader significance than just announcing the arrival of a visitor. In cases where the dog is highly reactive to the bell, it can be disconnected, or visitors might be encouraged to knock on the door instead. Training dogs that become agitated during greetings to bark on cue may be useful to shift their alarm-barking behavior slowly from conflictive motivations toward a more appetitive incentive. Naturally, this approach is most effective with dogs that have strong appetites. Perhaps the most important training needed to improve control during greetings involves attention training and establishing basic leash control, especially focusing on controlled and slack-leash walking. Orienting/TAT that incorporates periodic positive prediction error (surprise) is a highly effective preliminary strategy for establishing control over excessive barking and reduced impulse control. In cases where the dog becomes highly aroused to the sound of the bell, a family member [familial intermediary (FI)] can go outside and bring the guest inside the house. A rival/model procedure can be used at such times, whereby the guest is given a highly desirable food item or toy by the FI. The guest should show interest and gratitude but return the item to the FI, who in turn gives the item to the dog. Afterward, the guest and FI can exit the house, followed shortly thereafter by the dog and handler. Perhaps the best way for the dog to habituate to the novelty of an unfamiliar visitor is by

going for walks. For highly reactive dogs, such familiarization efforts should be performed in advance of counterconditioning. The familiarization process appears to be largely mediated by habituation. A great deal of behavior therapy is involved in facilitating familiarity on a number of sensory levels. Repeated and noneventful exposure gradually helps to reduce aggressive reactivity in many dogs, but not all.

During the enactment of staged greetings, aggressive dogs should be kept on a muzzle-type halter hooked via a closed-loop leash to a limited-slip or prong collar. In the case of owners uncertain of their ability to control the dog, the dog should be muzzled or crated during greetings. The dog can also be kept on the same leash-and-collar arrangement while outdoors (see *Halter Collars* in Chapter 1). Dogs expressing a rigid watchdog attitude or an established history of serious aggression toward visitors are best kept on leash and muzzle or crated during visits.

Ideally, in anticipation of a visit, the owner should practice ringing the doorbell and pairing the event with a treat tossed against the door and repeatedly rehearsing the dog's role, using both reward-based and directive means to establish reliable control. Whenever possible, asking visitors to call a few minutes before their arrival can help time such preliminary preparation and training. In the case of highly reactive dogs, the owner and dog can meet the visitor outdoors and take a walk. At such times, the visitor is instructed to walk 15 or 20 feet out in front, and the dog is walked in the controlled position on the left side. Pulling is consistently countered with appropriate leash prompts and directive control efforts. The visitor can be instructed to fade back by slowing down and staying safely to the left or right of the owner and then to go back in front again. The visitor can also be instructed to turn about and approach the owner and dog frontally following a wide arc first away from them and then toward them. Gradually, more direct frontal approaches can be practiced. The trainer usually plays the visitor's role, at least initially. If the dog shows signs of habituating, a greeting at the door may be staged. As the doorbell rings, the handler tosses a highly valued treat against the door, taking advantage of the click as it glances off the door, and draws the dog's attention to it. The idea is to link the doorbell with surprise of sufficient strength to antagonize aggression-instigating associations established with the bell sound. The dog is prompted away from the door and drawn to the handler's left side (starting exercise), where it is prompted to sit. In some cases, a large and highly attractive food item is left outside for the visitor to find and give to the dog. As the item is placed on the floor and the handler releases the dog to take it, the guest should not attempt to directly interact with the dog. Subsequent rewards are delivered in accordance with a differential reinforcement of other behavior (DRO) schedule, whereby the dog is given a food reward of variable value after a brief period, regardless of ongoing behavior, provided that no threats or barking occur during the DRO period. When the DRO criterion is satisfied, a smooch or squeak previously conditioned in the context of orienting/TAT is delivered to cause the dog to orient, followed by a click or "Good" as the dog makes eye contact with the handler. A flick of the right hand is used to deliver the reward. If the dog fails to orient within a 1-second limited-hold period, the reward is lost and the dog is prompted to turn about by taking two or three steps back, whereupon it is guided into the starting position and rewarded. As the dog is focused, it is released and the DRO schedule is reset.

During this phase of training, a pattern of control and reward is established that encourages more cooperative behavior and a perception of safety. The repeated activation of an orienting response appears to produce a significant calming effect (see *Autonomic Arousal, Heart Rate, Aggression* in Chapter 6). The handler should give the dog treats until it begins to relax, whereupon the guest is invited to make the squeak or smooch sound as the handler continues to deliver the click and food rewards, gradually encouraging the dog to make eye contact. Eventually, the guest is given treats to toss on the floor for the dog to take. After brief preliminary training, most dogs can rapidly learn to accept the presence of a visitor on limited terms. However, some

dogs may persist in threat barking and other displays that strongly recommend inhibitory measures for control. During exposure procedures, any aggressive lunging is countered with a directive leash prompt with the dog taken to time-out (TO). The combined punitive and dearousing effects of TO can be highly useful for controlling such agonistic excesses (see *Time-out* in Chapter 7). TO is initiated with a firm tone of voice ("Enough, Time-out"), whereupon the dog is abruptly hauled through the front door. The door is then shut on the leash, giving the dog just enough room to stand and sit on the other side. Provided that the dog is not barking, after 30 seconds it is brought back inside with a squeak, orienting response, click, and food reward. A food reward is delivered according to a brief DRO schedule (3 to 5 seconds), provided that the dog does not show threatening behavior. If the dog begins to bark again, the TO is repeated in a similar way, and additional TOs are applied as needed. Repeated TOs appear to mobilize passive modal strategies, which can be complemented by using a modified DRO schedule as previously described. Not only do such rewards help to reinforce prosocial behavior, they also serve to produce a calming effect by evoking emotional arousal incompatible with anger and fear. Most importantly, however, surprise generates active modal strategies in association with the activation of the seeking system—arousal and behavior incompatible with an aversion for social novelty. Whenever possible, massed trials are staged at the door until the dog appears to welcome the entry of the guest (e.g., the trainer). The preliminary exposure and habituation process combined with staged greetings helps to process the integration of scripted roles and social rituals in accordance with safe expectations, thereby building a foundation of trust and an anchor of continuity extending to future encounters with the same people or other unfamiliar people visiting the house.

A cycle of PFR training can also be performed in the presence of a visitor, but usually only after preliminary control has been established. Before attempting to perform the PFR procedure in the presence of a visitor, the dog should receive several cycles of PFR training and olfactory-signature conditioning (see *Appendix C*). After staging a greeting, as previously described, the guest is brought into the house and situated at a nonintrusive distance away from the dog and instructed to inch forward slightly at each step of the PFR cycle. The gradual approach is continued until the dog is in the lateral-control position. The visitor should not continue the gradual approach if it disturbs the dog and should not come closer than 6 feet of the dog. Any efforts by the dog to get up should be blocked and the PFR process resumed. A previously conditioned dilute odor (olfactory signature) can be used to initiate the massage cycle to facilitate the relaxation response. Each step in the cycle should produce a relaxation response before proceeding to the next. If necessary, the dog can be muzzled during the massage, but at minimum it should be kept on a muzzle-clamping halter attached in a closed-loop fashion to a limited-slip collar (see *Halter Collars* in Chapter 1). Before the dog is released from the last step of the PFR procedure, the visitor is instructed to move back slowly to a safe distance. When the dog is released, the visitor is instructed to make a smooch sound, whereupon the handler should quickly click, reward the dog, and then continue to give variable food rewards on a DRO schedule, providing the visitor with treats to toss (not give) to the dog. The olfactory signature can be dispensed from a scented squeaker, a compressed-air pump, or by other nonobtrusive means. For example, a tissue can be scented and placed in the handler's pocket. When needed, the tissue can be rubbed between the fingers and the odor presented to the dog. The scent can also be passively delivered by putting a small amount of it on the doorknob or entry mat. Another passive method used to transfer the scent is by handshake. The goal of the conditioned odor is to modulate reactive emotional arousal and make the dog more receptive to social engagement and calming efforts.

Precautions in the management of potentially aggressive dogs should lean heavily on the side of safety to fully protect the guest from an attack, as well as to protect the dog from the consequences of biting. Again,

depending on risk and circumstances, the dog may need to be muzzled, confined in a crate, or locked in a bedroom. If restrained in a bedroom, the door must be locked. Visitors have been attacked as the result of accidentally entering a bedroom while searching for a bathroom, for example. Finally, great care should be taken when releasing a dog from such confinement before the visitor has left the home. Many dogs after a period of restraint or confinement can lull owners into believing that they have accepted a visitor's presence. Instead, upon being released from confinement, such dogs may simply trot straight to the visitor and without hesitation attack them. Dogs that have bitten or attempted to bite visitors in the past should not be permitted to take food from a guest's hand, even though it may appear safe to do so. In the early stages of the training process, the guest should be discouraged from making eye contact with the dog; however, once some trust has been gained, progressively more natural social exchanges can be explored in association with orienting and attention training. The dog should be kept on leash and maintained under close control during the entire visit, perhaps kept in a down-stay at the handler's side and provided with periodic massage to support a relaxation response.

An alternative to crate confinement or isolation is the tie-out station, which consists of a length of quarter-inch nylon rope or a vinyl-coated steel cable for dogs at risk of chewing through the line. The line is fitted with a bolt-swivel snap and securely attached to an eyebolt fastened to a wooden beam in the wall. The length of the tie-out cable should not exceed the length of the dog's body plus a half. The tie-out location should be situated in such a way that there is no risk of the visitor coming into too close proximity with the dog. While on the tie-out, the dog should also be kept on leash, with the handler applying appropriate leash prompts to prevent straining, lunging, or rearing up. A tie-out arrangement is useful with particularly aggressive dogs. The tie-out station also gives the handler more freedom to handle the various training paraphernalia without worrying about losing control of the dog. In some cases, an active-control line can be used in combination with a tie-out. The active-control line enables the trainer to exert directive control over the dog while at the same time giving it more freedom to move about. An active-control line is a good compromise between the secure restraint of the tie-out station and the reduced control provided by a leash alone.

As previously mentioned, some extrafamilial aggressors are particularly dangerous at times when guests get up to move around the house or when preparing to leave. Many people have been seriously bitten while reaching down to offer the dog an unwelcome farewell pet. Others have been bitten as they stop petting and say "Good-bye" to the owner. The gradual appearance of acceptance shown by a dog toward a guest during a visit with lots of rewards may lead the owner into a false estimation of the risk. Since highly impulsive dogs (rigid watchdog type) may react aggressively to the increased activity and excitement associated with departures, at such times the dog can be maintained in the starting position or prompted to maintain a sit-stay or down-stay as the visitor gets up and prepares to leave the house. This procedure can be repeated in massed trials, so that the guest getting up comes to be associatively linked with the sitting or lying-down response. In some cases, a PFR cycle can be initiated to precede the guest's getting up and preparing to leave the house and continued a minute or so after the guest has left the house. During PFR training, the dog should be appropriately restrained on leash by means of a muzzle-clamping halter or muzzle, as necessary to ensure safety. Otherwise, the handler should restrain the dog and take appropriate precautions as the visitor prepares to leave the house. As the visitor steps through the doorway, he or she can toss the dog a highly valued food item or toy before closing the door. Careful management, restraint, and safe exposure are crucial for the successful control of such problems.

Aggressive Barking, Lunging, and Chasing

On walks, many precautions need to be taken to head off problems. Both children and

adults enjoy meeting and petting strange dogs on the street. Some extrafamilial aggressors can be surprisingly tolerant of social contact when away from home, whereas others may be more aggressive or unpredictable toward people approaching them when in unfamiliar places. Even with dogs that have a history of aggression toward visitors but appear to be friendly under such circumstances away from home, a difficult-to-assess risk may be present that advises against allowing the dog to have casual contact with the public. As a result, the handler should forewarn anyone attempting to approach the dog about the potential danger and even physically block contact, if necessary, especially if the dog is not wearing a protective muzzle. A muzzle-clamping halter does not protect against such close-quarter attacks and may actually worsen the severity of the bite by causing the dog's jaws to clamp down and hold as the dog is yanked back or the victim attempts to pull away. Many extrafamilial aggressors are particularly reactive in the car, and care should be taken to keep windows rolled up to prevent foolhardy fingers from being injured or lost. Dogs that threaten or lunge at passersby need to be handled assertively to discourage such behavior in the future. Consequently, it is critical that dogs exhibiting such problems learn to walk on leash without pulling. The inhibitory control established in the context of leash training has a generally beneficial effect on a dog's ability to control reactive behavior in response to social and nonsocial change.

Fast-moving objects, especially rapidly accelerating ones in the dog's immediate vicinity, may stimulate a chase-and-grab sequence. Running children, bicyclists, or joggers suddenly appearing and moving rapidly through the dog's home space or along a driveway or property line may instigate intense aggressive arousal in certain dogs. The acquisition of a reactive response to stimuli combining novelty, sudden change, and rapid movement may be highly prepared in predisposed dogs and organized at an early age. Puppies showing signs of reactive behavior in response to the approach of strangers or sudden change should be gradually exposed to provoking stimuli in order to promote habituation, to develop new associations, and to improve impulse control via appropriate control efforts. Many dogs appear to enjoy the invigoration and control associated with the chase-and-threat sequence (see *Drive Systems, Aggression, and Behavior Problems* in Chapter 6). Less confident dogs may be emboldened under the influence of handler reassurance, food, and forward movement. In addition, aggressive threats may be reinforced by a perception that they succeed. Even in cases where the target is not actually influenced by the dog's threats, it may appear from the dog's perspective that its threats caused the intruder to go away; passersby may seem to flee in response to the dog's barking and threats. As the result of barking and running fence lines in response to the approach of passersby, such dogs may become progressively frustrated and annoyed. If they finally succeed in breaking through the barrier or the target attempts to approach them, a serious attack may follow.

The allure of chasing moving objects can be so potent that dogs will often continue to engage in the behavior even after being hit and seriously injured. One particular dog comes to mind that had developed the peculiar habit of chasing and biting the tires of service trucks on a university campus. While lunging and poking around a rear tire, he managed to get his head stuck under the wheel. The dog suffered multiple facial fractures as his head was pushed into soft ground that probably prevented more severe, or fatal, injuries. The dog remained conscious, presumably fully aware of the entire ordeal, and fully recovered, but to the chagrin and amazement of the owner, almost as soon as the dog was well enough to play on the campus lot again, he resumed the same pattern of chasing and worrying the service vehicles that nearly killed him a few weeks before. The dog's passion in life was focused on barking and biting at the tires of slow-moving vehicles. Such dogs require preventive management, alternative outlets, intensive attention therapy, leash training, halt-stay and recall training, and inhibitory conditioning. Although significant progress can be obtained via reward-based training and play therapy, the competing reward associated with the periodic opportu-

nity to chase may be potent enough to maintain the problem behavior. When performed in the context of reward-based training, electronic training can be highly effective in controlling such problems (see *Electrical Stimulation and Chasing Behavior* in Chapter 9).

When in contact with the public, dogs with an established propensity to threaten or bite people should be appropriately restrained by a muzzle or a muzzle-type halter. Since such dogs can easily back out of certain halter designs if they are put on too loosely, the halter should be hooked in tandem with an oversized slip collar (see *Conventional Slip Collars* in Chapter 1) or used in combination with a limited-slip or prong collar via a closed-loop or two-leash arrangement. The slip collar provides a source of added security and backup control if the halter fails. For example, dogs can escape by struggling vigorously against a halter and backing out of it. These canine escape artists can shift the muzzle loop forward by pulling against the leash and sharply wiggling in such a way to cause the loop to slip over the nose, thereby making the halter come off their head. A dog can also break free when an owner nervously attempts to hold the dog back by grabbing the neck strap of the halter and in the process inadvertently squeezes the side-release buckle, releasing the dog. Flimsy plastic buckles should be replaced with metal fasteners. Occasionally, a collar may come apart due to defective sewing or hardware; consequently, every new halter or collar should be carefully inspected and tested for strength before it is used. The author once found that a brand new halter was held together at a critical juncture by only two loose threads. The halter was being fitted on a large and extremely aggressive dog—the extra time spent to inspect the halter narrowly averted disaster. Finally, moleskin can be attached to the underside of the muzzle loop to prevent chaffing and friction sores in the case of highly reactive dogs prone to struggle against the halter. To avoid these problems, the halter needs to be properly fitted and introduced. Unfortunately, novice owners with aggressive or reactive dogs may unwisely attempt to use such devices without hands-on instruction appropriate to the dog's individual needs—a formula for a potential disaster (see *Opening the Training Space*).

Dogs exhibiting an established pattern of extrafamilial aggression away from home should receive thorough orienting/TAT, intensive basic obedience training, graduated interactive exposure with response blocking, and inhibitory conditioning, aimed at enhancing attention and impulse control. Preliminary training should include *reliable* leash-control and stay behaviors. Training a dog to orient away from a target and to make eye contact or to sit or lie down without hesitation on signal and to stay there until released are essential training objectives. The dog gradually learns to cope with the approach of a target by increasing impulse control and turning its attention toward the handler. Interactive exposure with response blocking and reward of behavior incompatible with the chase or threat sequence may help to reduce reactive arousal contributing to the behavior (see *Social Fears and Inhibitions* in Chapter 3). Response blocking or diversion and differential reinforcement of other (DRO) or incompatible (DRI) behavior offers many potential benefits once adequate inhibitory control over impulsivity is in place. Without opening a viable training space via preliminary inhibitory conditioning, most reward-based behavior-therapy efforts are unlikely to succeed and might actually make matters significantly worse. To proceed efficiently with interactive exposure procedures, all evocative situations need to be identified and ranked so that a hierarchy of exposure stimuli is obtained, ranging from least evocative to most evocative. For example, dogs that chase cars might first be exposed to a parked car and then to a slow-moving car, a moving and stopping car, a normally moving car, and so forth. At each stage, barking and lunging behaviors are interrupted or blocked by means of a stop-change or all-stop inhibitory procedure, followed by appropriate reward (e.g., petting and massage) as the dog defers to the limit set on its impulsive actions. In addition to DRO/DRI training using food, ball play can often be introduced in such situations as a substitute source of stimulation and reward. From behind the safety of a

fence, ball tug and fetch and flying-disc play offer the dog a substitute outlet to chase and grab, as the impulse to chase forbidden things is suppressed.

A solid recall and halt-stay response should be established on leash and long line and honed to a high level of proficiency. A long line with a limited-slip collar tied into it can be highly useful for establishing an all-stop response. The long line requires skill to use safely and effectively (see *Leash and Long Line* and sections on stay and recall training in Chapter 1). Preliminary training (e.g., attention, following, recall, and halt-stay) and practice with the long line is begun in a fenced backyard or similar area. When using the long line to discourage impulsive charging, a length of rope is laid out and stepped on firmly at a point that gives the dog enough slack to generate a running speed and momentum that will generate a significant and lasting impression as it is brought to a dead halt. The length of rope set off for the procedure is determined by the specific needs of the dog and should be adjusted to prevent excessive or unnecessary force. A temporary handle is tied into the long line approximately 6 feet beyond the point selected and held with both hands as previously described for holding the leash in Chapter 1. The long line is held as a backup and to turn the dog about or prompt it to come, if necessary. The halt-stay procedure is performed with the dog on leash and long line. Once an impulsive response reaches the point of no return (all-go response) and slips out of inhibitory control, directive or saccadic prompts of sufficient force to counter the dog's forward momentum and turn it about are frequently necessary to regain control (all-stop response). As the dog pulls toward the target, the leash is dropped and the trainer shouts firmly "Stay!" or "Stop!" and braces by shifting weight over the foot standing on the long line and firmly grips the line with both hands. As the dog is brought to an abrupt halt, the trainer approaches the dog or calls it back and, after a brief recovery period, the dog is again exposed to the target with attention and DRO/DRI training. Most dogs show a marked all-stop response to the vocal countermand after one to three exposures to the foregoing procedure. Additional control over the all-stop response can be established by means of practice with throwaway objects (see *Stay Training* in Chapter 1).

In addition to all-stop training (dead halt and stay), stop-change and go/no-go inhibitory training is intensively practiced. The orienting response is repeatedly bridged and rewarded with food to capture and focus the dog's attention on the trainer and to evoke an appetitive establishing operation. As the target is spotted at a nonprovocative distance away, the orienting stimulus is delivered, and a hand and vocal signal is used to prompt the dog to hold a stand or sit. Any efforts made by the dog to move forward or to get up while sitting are preemptively countermanded by appropriate vocal, physical, or leash prompts. As the dog begins to sit, the bridging stimulus (click) is delivered and followed by a food reward of variable value together with relaxing petting and massage aimed at calming and soothing the dog. The dog is periodically called by name and/or a smooch or tongue click sound to make eye contact and is rewarded. So long as the dog orients and makes brief eye contact, a food reward is delivered. If the dog fails to orient and make eye contact or becomes agitated, it is turned about and moved away from the target before being turned around at a less provocative distance for the procedure to be repeated. As the dog's tolerance for contact improves, down-stay and PFR training (e.g., collar, stand, sit, and down controls) is introduced to enhance inhibitory control further.

Effective counterconditioning depends on gradual, nonthreatening exposure to unfamiliar places and provocative target stimuli in combination with appetitive and emotional stimulation (e.g., food, touch, and play) that is incompatible with aggression and fear. The counterconditioning process moves from the least provocative to the most provocative situation. A variety of motivational, contextual, and proximity factors impinge on the efficacy of counterconditioning efforts (see *Stimulus Dimensions Influencing Fearful Arousal* in Chapter 3). Several counterconditioning variations are used, depending on the dog and

problem. The least provocative technique involves walking the dog toward the target and having the dog sit every few steps. A more provocative variation involves having the dog sit and stay as the target gradually moves toward the dog. Here, the target takes several steps toward the dog and stops, whereupon the handler provides the dog with appropriate appetitive or tactile stimulation to offset aversive arousal. In either case, if the dog becomes overly aroused, it is abruptly turned away from the target and walked back to a less provocative distance and the process started over again. Another method involves having the dog follow the target person, who is instructed to drop treats every few feet while moving away from the dog. This procedure can be modified to initiate a searching game, whereby the dog is encouraged to follow a trail of treats laid down by the unfamiliar person. In the beginning of the trail, treats are laid down evenly and frequently (e.g., every 10 feet), but gradually the trail of treats is more randomly spaced requiring that the dog search for clues, including the person's body odor or an odor applied to the person's shoes. Changing the size, frequency, or type of food laid on the track can generate cortical reward and facilitate the process. The combination of the olfactory incentive system, forward movement, and seeking activity may exert a positive effect on the dog's response to the signature odor of the person, perhaps facilitating social familiarity and counterconditioning efforts. Whatever method is used, the objective is gradually to replace reactive arousal elicited by the approach of strangers or persons not belonging to the household with appetitive anticipatory arousal and positive social expectancies conducive to social attraction and friendly behavior. Other variations used during graduated exposure include the approach of groups, situations involving loud noises or boisterous activity, exposure at different times of day (some dogs appear to be more aggressive at night), and varying the speed and naturalness (oddity factor) of the approaching target. Another possibility involves having the target walk back and forth on the horizon line, forming an arc that progressively opens toward the dog, causing the target to come closer and then recede. On succeeding trials, the curve of arc becomes increasing steep as the distance traveled on the horizon line is narrowed. Each variation of exposure to change and novelty should be arranged along a continuum of evocativeness to prevent reactive responses.

Dogs that become reactive during exposure procedures can be dearoused by means of TO. Ideally, the outdoor TO is performed at a tie-out station set up in the open or behind a blind. The tie-out line is wrapped at least twice around a sturdy post and then fixed in place with a carabiner hooked into the handle and snapped onto the line. The tie-out line is positioned on the post to give the dog enough room to stand comfortably or to sit but not lie down. A bolt-swivel snap is used to fasten the tie-out line to the dog's collar. A blind is constructed from two 5-foot by 1-inch PCV tubes that are cut at a sharp angle so that they can be easily pushed or pounded into the ground. For a medium-sized dog, a piece of light cloth material is cut into a 4-foot by 7-foot rectangle, and both ends are folded over and sewn (or stapled) into sleeves large enough for the support poles to be inserted. A center post can be inserted to pull the blind and form an inverted V shape. The blind is rolled up on one of the support poles, making it easy to unfurl and set up. During time-out, the trainer sits in front of the blind while holding a leash attached to a muzzle-clamping halter. In addition to TO, the blind can be very useful for controlling and varying exposures to the target during counterconditioning.

The TO procedure is initiated by saying "Enough, time-out" and then assertively hauling the dog to tie-out post. After 30 to 60 seconds or when the dog has been quiet for at least 10 seconds, the trainer signals approval ("Good boy/girl") and returns to the dog, releases it, and initiates attention and DRO/DRI training at a previously nonprovocative distance from the target. Additional TOs are repeated as needed to control arousal levels and discourage overt aggression. Under conditions that allow it, the TO procedure can include a walk-away consequence, whereby the trainer leaves the dog and waits in a concealed location. Persistent barking

excesses associated with TO can be discouraged by means of a leash attached to a muzzle-clamping halter or by pairing an all-stop vocal signal (e.g., "Enough") with a conditioned odor and compressed-air startle or the sound of a shaker can delivered from behind the dog. As the barking ceases, the trainer returns to the dog and initiates attention and DRO/DRI training to maintain quiet behavior. Bark-contingent muzzling may be useful in some cases of persistent barking, but long periods of muzzling should be avoided, especially in warm weather when unimpeded panting is needed for thermoregulation. In refractory cases, a remote-activated training collar can be effectively used to facilitate the rapid inhibition of barking behavior.

PART 2: INTRASPECIFIC AGGRESSION

With the exception of certain breeds developed for an exaggerated propensity to fight, the dog's domestication has generally resulted in an elevation of the reactive thresholds controlling intraspecific flight-or-fight behavior while selecting for traits conducive to social affiliation and play. Unlike the animosity typically shown by wolves toward unfamiliar conspecifics, the majority of dogs are far more likely to exhibit friendly interest and affiliative behavior toward unfamiliar dogs. Aggression between dogs is under the motivational influence of a variety of social factors (e.g., relative familiarity, playfulness, and tolerance for close interaction and contact) and emotional tensions (e.g., fear, anger, frustration, and irritability). When functioning properly, ritualized agonistic exchanges and transactions may serve to reduce overt fighting; however, as the result of genetic predisposition, developmental stress, socialization deficits, or traumatic learning (e.g., being attacked by another dog), a dog's ability to send, receive, or reciprocate agonistic signals appropriately may be disrupted.

HIERARCHY, TERRITORY, AND THE REGULATION OF AGGRESSION

Among wolves, cooperative order within the family/pack appears to develop in the context of an emergent leader-follower bond established in association with a natural tendency for the young to follow the breeding pair. Social dominance and leadership are expressed in a division of labor between the male and female, whereby the male defends the living space against intruders and leads hunting activity aimed at procuring food for the mother and offspring, and the female defends the den and immediate core surroundings and leads activity dedicated to offspring care and protection (Mech, 1999). Active submission and greeting behavior appears to develop in association with food begging, whereas passive-submission training carried out by adults appears to constrain obtrusive behavior. Regurgitation and the cooperative provision of other stores of food by the wolf parents sets the stage for sibling social differentiation (sibling dominance hierarchy) based on their relative abilities to compete successfully for limited food rations. With the introduction of solid food and an increasing unwillingness of the mother wolf to nurse, a process of weaning slowly transitions the pup from a completely dependent status to a progressively independent relation with the parents. Wolf behavioral ontogeny transitions through several developmental stages from complete vulnerability and dependency to a state of self-reliance, independence, and dispersal to form a separate family and home range.

Among wolves, dominance is most predominantly correlated with the procurement, ownership, and distribution of food, scent-marking behavior, and the defense of territory. Territorial claims are secured by means of residency, advertisement (e.g., scent marking and vocalization), mutual recognition and avoidance of the territorial claims of others, and the capacity to eject intruders (see *How Territory Is Established and Defended* in Volume 2, Chapter 7). Scent marking is the prerogative of the breeding pair or more rarely subordinates ascending in rank (Mech, 1999; Peterson et al., 2002). The breeding pair often engages in double marking, especially during the breeding season (Asa et al., 1985; Mertl-Millhollen, 1986). The double-marking ritual may help to establish a strong pair bond prior to estrus. Coyotes living in packs exhibit a

similar pattern of scent-marking behavior (Gese and Ruff, 1997). Scent marking appears to be well suited for the demarcation of territorial boundaries. Odor signals do not depend on the immediate presence of the signaler to be effective, they can be deposited in small amounts over a large area, and they persist for a long time after being deposited. The distribution of scent marks provides a spatial and temporal record of the signaler's past activities and likely whereabouts, thus improving the ability of neighboring conspecifics to avoid contact and potential animosities (Peters and Mech, 1975). At closer distances, vocal indicators of presence (howling) (Harrington and Mech, 1979) and barking threats (Mech, 2000) may advertise residency and warn intruders of trespass. Actual attacks on conspecific intruders are initiated and led by the breeding male (Mech, 1970).

Whether dogs use urine to demarcate territory remains controversial (see *Urine Marking and Territory* in Volume 2, Chapter 7) and, although a communication function appears to be involved (Bekoff, 1979a and b), the precise nature of the message and its function remains enigmatic. Bekoff (2001a) collected data regarding a dog's sniffing and urine-marking habits over 5 years. The dog marked somewhat more frequently over the urine of other males than females and only infrequently urinated over its own urine spots. These findings support previous work indicating that the trigger for urine marking is the scent of another male or female dog (see *Eliminatory Behavior* in Volume 2, Chapter 9). Pal (2003) has reported that free-ranging dogs are more likely to mark after observing another dog mark, suggesting that the leg-lifting action may perform a visual releaser function. Raised-leg displays (RLDs) (leg lifting without urinating) were found to occur frequently after competitive interactions involving territory and courtship, indicating that such behavior might serve an agonistic function. Similarly, Bekoff (1979b) reported that RLDs occurred most frequently while another dog was present. Among free-ranging dogs, urine marking is more frequent during the breeding season in areas associated with courtship and territorial boundaries (Pal, 2003). Also, dog mothers scent mark more frequently near the den site, perhaps with the intent of warding off intruders, but there is little evidence that dogs avoid areas scented with urine. Increased scent marking by male dogs appears to occur in association with the trespass of territorial boundaries and in response to finding unfamiliar objects within the territory. High-ranking male dogs appear to mark over urine deposits left by estrus females, suggesting to Pal that such marking may perform an ownership function. Pal also observed that dogs urinated on garbage and food left over after eating, and speculated that such marking might help dogs to find the food when they returned to the area. Pal refers to the work of Henry (1977) in support of the foregoing hypothesis. Henry, however, demonstrated that foxes urinated on inedible food items and substrates scented with traces of food so that such items and locations could be ignored when come upon in the future, thereby making scavenging activities more efficient. A similar *bookkeeping* function of urine marking has been reported in coyotes and wolves, providing further support for Henry's bookkeeping hypothesis; that is, cache marking is probably performed by canids and other species (Devenport et al., 1999) to help them to discriminate the absence of edible food (Harrington, 1981; Gese and Ruff, 1997). In the case of wolves, Harrington observed that, after emptying a cache, urine was deposited into the hole presumably to mark the cache as empty.

Dogs take an avid interest in the urine deposits of females, regardless of their reproductive status, suggesting the possibility that such investigation and urine marking may serve a similar reproductive bookkeeping function. After observing a female urinate, the intact male often goes to the spot, investigates the urine with its nose or licks it, and then deposits a splash of urine nearby or directly on it. According to the bookkeeping hypothesis, the dog's interest in the female's urine may serve the purpose of collecting and appraising olfactory and pheromone information indicative of her reproductive status. The increased interest shown by males toward the urine of females in estrus may also be organized to

detect pheromone signals (e.g., methyl *p*-hydroxybenzoate) that are shed in association with the onset of ovulation (see *Vomeronasal Organ* in Volume 1, Chapter 4). The subsequent scent mark may not denote possession, but rather serve to let the marker know that the spot had been previously checked. Dunbar and Buehler (1980) have suggested that dogs might urinate over female scent marks in order disguise or mask them, ostensibly with the goal of throwing other males off the female's scent. Urine marking by male dogs preceding a fight may transmit identifying olfactory information that is associatively linked with the outcome of the agonistic encounter. According to this hypothesis, urine deposited by the winner may not only serve to weakly conceal the female's scent, as proposed by Dunbar and Buehler, but, more significantly, the winner's urine may evoke active avoidance of marked spots, thereby deterring closer scrutiny and discovery of the female's reproductive status.

Another plausible function of urine marking is related to *securing* an unfamiliar place or object by rendering it familiar with the dog's urine scent (Kleiman, 1966) (see *Behavioral Effects of Domestication* in Volume 1, Chapter 1). According to this hypothesis, urine deposits may at least indicate to a dog that it is on ground that had been safe in the past. Urine deposits may also provide information about the shared use of an area (Eisenberg and Kleiman, 1972), performing something akin to a public bulletin-board function (see *Urine Marking* in Volume 2, Chapter 9). Observing the urine marking of other dogs may prompt close investigation of the spot, followed by double marking, a ritual that frequently anticipates sexual play and the integration of friendly relations between male dogs not sharing the same household. In some cases, however, dogs may urinate in close association with hostile arousal and intent, perhaps performing the display as part of a preliminary ritual in anticipation of a fight (Ralls, 1971), whereas others may be more likely to mark under the influence of conflictive arousal and uncertainty. In both cases, urine marking might represent a nerve-steadying ritual, engendering confidence and place security, and briefly killing time before deciding on a course of action. Urine marking may also serve a cutoff function, occurring subsequent to the exchange of intense threats that are broken off before escalating into an actual fight. For example, Lorenz (1955) describes an agonistic encounter between two evenly matched dogs that concluded with the competitors slowly disengaging and saving face by mutually standing down and walking away in opposite directions, whereupon both eyed the other and simultaneously squirted urine against separate posts and left the scene without further incident. Ground scratching frequently follows urine marking. Bekoff (1979a) has observed that dogs performing the display may be avoided by other dogs during the activity and for a short time afterward, but they do not subsequently avoid the urine deposit and scratch marks.

The ancient phylogenetic origins of urine marking have probably resulted in a number of polymorphisms influencing the form and function of the rituals and displays associated with it. The significance of urine marking, like that of barking, probably depends on the survival mode active at the time and the context in which it occurs. A genetic factor appears to affect the urinating behavior of purebred and mixed-breed dogs, with purebred male dogs urinating more frequently than mixed-breed counterparts (Reid et al., 1984). The evident hypertrophy of marking behavior in purebred dogs may be a secondary characteristic resulting from the selection of dogs that readily and enthusiastically perform siring functions—a highly desirable and valuable trait in stud dogs. Purebred dogs are also most frequently implicated in household fighting—behavior that is sometimes also associated with household marking problems (Sherman et al. 1996). Sherman and colleagues interpret urinating/marking as a way that such dogs assert dominance and mark territorial boundaries, suggesting that such dogs should be prevented from performing the "alpha wolf behavior of marking territorial boundaries during walks" (107). Aside from practical considerations regarding how one might achieve such an intrusive prohibition without risk to desirable urination habits and

various other potential problems associated with the proposed treatment procedure (see *Urine Marking and Intermale Aggression* in Volume 2, Chapter 7), the underlying assumption that urine marking serves a territorial function in dogs remains to be convincingly demonstrated (see *Evidence for a Territorial Function of Urine-marking Behavior* in Volume 2, Chapter 7). The danger of placing undue emphasis on a threat-signaling function of urine marking was a concern of Eisenberg and Kleiman (1972), who admonished researchers to avoid thinking of scent marking as performing a territorial defense function:

> Thus, we must divorce ourselves from considering scent marks as a means of territorial defense; rather, we should think of scent as a means of exchanging information, orienting the movements of individuals, and integrating social and reproductive behavior. (24)

Furthermore, even if urine marking did deter territorial trespass, evidence of avoidance alone would not necessarily support the notion that the marking activity was performed with an agonistic or territorial intent:

> The thesis that scent marking in mammals arose from autonomic responses and evolved into a means of familiarizing the animal with its environment and reassuring it in unknown situations is very useful. It certainly does not exclude the numerous social functions which scent marking has gained during the evolution of the behavior, but it does imply that they evolved secondarily. This thesis also suggests that scent marking is not used as an agonistic display for territorial defense even though the behaviour is effective in maintaining a territory. Its efficiency simply lies in the avoidance responses which are shown by the intruding individual. (Kleiman, 1966:176)

Framing the Concept of Hierarchy and Territory

Wolf Family Life, Hierarchy and Territory, and Feral Dogs

The closely interwoven and complementary functions of hierarchy and territory cannot be arbitrarily separated and studied in isolation without losing significance. Just as the boundaries of a country are defended to protect cultural and political interests as well as economic assets, territory serves multiple social, reproductive, and ecological functions conducive to the viability of the group to survive and reproduce successfully. Among wolves family/pack defense is the prerogative of the breeding pair, with the breeding male leading attacks against territorial intrusions, while the breeding female appears to take the most active role in the defense of the den (Mech, 2000). Governance by hierarchy and territory appears to subserve reproductive goals and family survival functions by promoting the equitable distribution of family resources and by facilitating cooperative hunting and sundry other group activities conducive to reproductive success, group stability, and the survival of offspring (Mech, 1999). The reproductive significance of governance becomes strikingly evident if the breeding male dies. With the loss of the breeding male, subordinate members of the family/pack appear to be much less concerned by the intrusion by outsider males and may rapidly integrate social relations with them. At such times, territorial intolerance and animosities toward outsiders are dramatically relaxed, thereby giving dispersed males an opportunity to enter the home range and fill the vacancy as pack leader (Stahler et al., 2002). The cooperative governance, stable pair bonding, family organization, and cooperative care for offspring shown by wolves are not evident in feral dogs, suggesting the possibility that a functional system of governance by hierarchy and territory may not exist in dogs or is expressed in a significantly variable and modified form. Although a socially integrated group of feral dogs has been observed to show territorial aggression around the edges of shifting core areas where they spend most of their time in close association with food resources, resting and retreat sites, and dens (Boitani et al., 1995), they do not appear to exhibit the coherent social organization that is evident in the governance of the wolf family. Finally, in addition to the social function of territory, territoriality serves a valuable ecological function by spreading competing groups over a geographical region, thereby preventing overhunting and the

depletion of local resources while opening up new areas for exploitation. The territorial separation of small family/pack groups may also serve an important epidemiological function by slowing the spread of contagious disease that might risk decimating larger groups living in close proximity.

Social Attraction and Repulsion, Governance, and Canine Proxemics

Whereas territory moderates conflict by means of physical spacing, hierarchy moderates conflict by means of social spacing. Together, territory and hierarchy form a unified sociospatial complementarity in the regulation of conflict (Figure 8.3). The attraction and repulsion dynamics and sociospatial relations formed while organizing a default hierarchy is referred to as a *social space* (see *Horizontal and Vertical Organization of Social Space* in Volume 2, Chapter 7). Typically, interactive conflict is triggered by dyadic-control vectors converging on some point of common interest that can support only one interactant at a time (e.g., possession of a bone, resting spot, or mate). The mutual agonism and affiliation associated with the formation of sociospatial relations is expressed in attraction-repulsion fields that radiate out from the point of common interest or conflict along a gradient of decreasing conflict and repulsion. *Axipetal forces* consisting of appetitive and social attraction draw the repulsed subordinate back toward the point of common interest and the center of social space, whereas *axifugal forces* consisting of social repulsion produce dispersal dynamics that cause the subordinate to withdraw and stay away. These forces of appetitive and social attraction and repulsion are reflected in canine-proxemic relations (see Hall, 1963 and 1968), affecting the various ways dogs use and regulate close social space and tactile contact in the process of attuning (coregulating) to one another and human companions. Essentially, sociospatial relations are the result of the expansion and contraction of social space in association with the establishment of hierarchy and territory. As such, hierarchy and territory represent the warp and weft of a single cloth of integrated social and environmental regulation referred to as *governance*.

Under circumstances in which a high level of appetitive and social attraction counters the repulsion generated during the establishment of sociospatial relations, the subordinate may be drawn back to offer sincere conciliatory-submission displays, seek acceptance from the dominant, and beg for nurturance and protection. If the dominant possesses sufficient social attraction to accept the subordinate's submissive efforts, collectively referred to as a *voluntary subordination strategy* (VSS), then a cooperative and harmonious relationship may develop between them via the formation of a leader-follower bond and interaction organized in accord with a principle of fairness, the mutual adherence to social codes, and the emergence of pluralistic ascendant and descendant relations. The development of ascendant and descendant relations within a shared social

FIG. 8.3. Attic red-figure vase by Andocides, ca. 510 B.C. Territorial aggression can be significantly escalated by social facilitation. Two dogs aroused by a common target appear to become a third entity in their union of animosity—a transformation reminiscent of the three-headed Cerberus, the monstrous dog guarding the portals to Hades in Greek mythology.

space provides several significant benefits for both the subordinate and the dominant members of the group (see *Unilateral, Bilateral, and Pluralistic Relations*). Whereas submission with attraction toward the dominant appears to generate affection, loyalty, and respect (i.e., secure social attachment), submission without attraction results in social ambivalence (anxiety, resentment, and contempt) in association with an *involuntary subordination strategy* (ISS) and entrapment. Under the influence of social ambivalence and entrapment, conflictive dynamics and tensions infiltrate the social space in the process of mobilizing dispersive dynamics and autoprotective behavior.

The dynamic axipetal and axifugal forces resulting from mutual attraction and repulsion produce a state of social equilibrium and integration (s and p types) or social disequilibrium and dispersal (c and m types). In addition to agonistic tensions, the organization and maintenance of social relationships is subject to stress-related modal switching that requires flexible coping skills and an ability to shift in accord with the activation and deactivation of survival modes. Attraction is a composite force consisting of appetitive and social incentives; as such, social attraction in the absence of appetitive security is not sufficient to maintain secure attachments, just as appetitive gratification in the absence of social affirmation and affection is also insufficient. Under the influence of insecure attachments and a reactive coping style, proxemic relations may become increasingly unstable under the disorganizing influence of social anxiety and contact aversion. Building secure attachments is a central focus of cynopraxic therapy, which places equal emphasis on bond-enhancing training and QOL enhancements—the yin and yang of cynopraxic therapy. Training without QOL enhancements or vice versa is not conducive to the attainment of cynopraxic objectives. The dynamic effects of survival-mode switching on the regulation of social attraction and repulsion represent a potentially valuable area for future study into the relationships between QOL, canine proxemics, and aggression.

Avoidance Learning and Despotic Hierarchies

According to the avoidance model of hierarchy, the establishment of hierarchical relations consists of an *escape phase* and an *avoidance phase*. During the escape phase, the dominant displaces the subordinate by severe threat or the infliction of pain or injury (if necessary) and thereby eliminates the conflict and takes control of the contested resource. The subordinate is doubly punished by the physical pain and injury resulting from the attack and the immediate and perpetual loss of control over the contested resource. Repeated defeat may cause the subordinate to experience increased social anxiety and depressed mood—psychological effects of defeat that may reduce testosterone and growth hormone levels, decrease immune functions, and thereby adversely affect the animal's fitness. Under similar circumstances, at least in the short term, the subordinate will fear and avoid the dominant and the places it occupies. In addition, the subordinate in the future may now respond to threatening intention movements (e.g., piloerection, direct stare, stiff frontal approach, and snarl) as discriminative stimuli controlling avoidance behavior (e.g., turning away and hesitation). Also, behaviors associated with the reduction or termination of attack (e.g., dorsal recumbency) may be used to interrupt the attack sequence. If these avoidance responses are successful, the subordinate may experience some degree of relief and relaxation—emotional sources of intrinsic reward that may support subordinate avoidance and antagonize fear. To the extent that subordinate avoidance responses work in this way, they will tend to promote feelings of safety. The subordinate's heightened responsiveness to the slightest tension in the dominant's gaze may cause the latter to feel securely in control, thereby reinforcing the threat sequence and perhaps reducing the likelihood of an actual attack. Threat gazing may be used to regulate subordinate behavior or prompt retreat, whereas averting eye contact by the subordinate may signal its prompt intent to move in a direction away from the conflictive encounter.

The threat of the dominant is an expression of anger held in check by competent emotional regulation and confidence that the subordinate will not fight back. While the threat display expresses an angry intent to attack held in check, the antithreat display of the subordinate is an antithetical intention movement geared toward immobility or flight that is matched to the perceived strength of the threat. When directed toward a subordinate, the dominant threat elicits fear. In contrast, agonism between two dominant individuals results in rapidly escalating threat exchanges based on mutual anger. In the case of equally dominant dogs, threats are reciprocated by counterthreats measured to accord with the perceived readiness of the other dog to attack until a flash point of no return is reached. Accordingly, threat displays induce anger in the dominant dog receiving them. The agonism between the dominant and subordinate dyad is kept in equilibrium by confirmative transactions consistent with anger/fear expectations formed as the result of past encounters. If the antithreat display given by the subordinate is delayed or insufficient (disconfirmed), the discrepancy between the expected antithreat display and the actual antithreat display may escalate threat tensions, that is, increase fear and anger. Under the influence of elevated anger, the dominant may intensify its threats, causing it to become increasingly angry and, if sufficiently provoked, launch into an attack. Alternatively, the subordinate, recognizing that the antithreat display given not only failed to reduce the threat but, in fact, increased it, may respond to the discrepancy by becoming more fearful, causing it to increase the intensity of the antithreat display, thus making it commensurate to the escalating threat of attack. In both cases, social signaling is exchanged under the modulatory influence of social feedback on control incentives, anger/fear-establishing operations, and prediction-control expectancies. The gestural conversation between the competitors is adjusted in accordance with discrepancies between the size of the threat given and the latency/size of the antithreat display reciprocated. Antithreat displays that match the expectations of the dominant result in a de-escalation of threat tensions, whereas mismatches result in the escalation of threat tensions, perhaps followed by an attack and defeat while reinforcing the dominant-subordinate relationship and increasing the subordinate's future readiness to show antithreat displays when challenged.

Consequent to a successful attack, the dominant is doubly rewarded by the emotional elation of enhanced power and the control established over the contested resource. As the result of similarly successful attacks on other group members, the aggressor systematically consolidates power and exploitative control over the group's resources. Group subordinates may similarly compete among themselves until a hierarchy of power relations is established. As a general rule, more extraverted and fearless (bold) group members tend to dominate and exploit more introverted and fearful (shy) members. As the result of receiving the most attacks from other group members, individuals at the bottom of the nipping order may be most adversely affected physiologically and psychologically by formation of a rigid hierarchy. However, a despotic dominator also stands to lose out and may not ultimately reap the benefit of its power exploits. The power gained by the dominant is won at the cost of bond-enhancing interaction with subordinate group members—a factor that may influence its a ability to function effectively within the group. The increasing success of the dominant to intimidate and exploit other group members promotes social avoidance and the gradual degradation of social attraction and attachments. The loss of social ties with group members may mobilize dispersal dynamics that marginalize the dominant (ostracism) and gradually cause its expulsion from the natal group (see Bekoff, 1977). As a result, the despotic hierarchy appears to be in the long-term advantage of middle-ranking individuals, who can interact on a friendlier basis with one another and thereby form stronger group ties.

Among dogs, submission rituals appear to serve important social modulatory functions that offset the adverse effects of hierarchy formation by helping to decrease social distance and facilitate reconciliation by paradoxically

increasing social attraction in response to dominator threats and attacks. The formation of hierarchy is not merely the outcome of avoidance learning but also involves the molding of social attachments via submission and reconciliation rituals. These affiliative rituals mediate enhanced attachment by establishing exchanges and relations that regulate aversive emotional arousal produced in association with agonistic threats or fights. Consequently, the formation of dominant-subordinate relations in the absence of social attraction, submission, and reconciliation promotes dominant intolerance/irritability or *contact aversion* and subordinate anxiety, resentment, and avoidance. Accordingly, dominants that fail to attract affectionate submission displays or fail to accept and reconcile with subordinates subsequent to agonistic conflicts may weaken social attachments and reduce the ability of the competitors to form social attachments in the future, thereby increasing the risk of setting into motion dispersive tensions. The lowest-ranking member (omega) faces a similar risk of dispersal in situations where social avoidance replaces submission and reconciliation rituals in the process of constructing a nipping order. Whereas all group members may be compelled to avoid the increasingly intolerant and irritable dominant, the omega may be compelled to avoid all other group members and enter into a similar condition of social marginalization but on the opposite end of the hierarchy. As a result of reduced social attraction and affiliation, both the despot and the omega may fail to form social relations conducive to secure attachments. In social situations that bar dispersal, the marginalized dominant and omega may become increasingly irritable, intolerant, and reactive toward interference by other group members.

Unilateral, Bilateral, and Pluralistic Relations

The foregoing inherent limitations affecting the despotic model of governance appear to be addressed by evolution of a pluralistic form of social governance based on the primacy of social attraction, social codes, and fair play. In contrast to the unilateral avoidance relations making up the despotic hierarchy, the pluralistic model of social organization differentiates between unilateral avoidance relations and bilateral ascendant-descendant relations organized in accordance with a principle of fairness. Within a pluralist system, a default hierarchy informs the structure of the relationship, but hierarchy relations do not define the sociospatial and dynamic content of the relationship. In pluralistic systems, dyadic attraction and repulsion dynamics appear to shape social attunement strategies organized to establish stable and harmonious group relations. Whether two dogs fight over a common object of interest depends on default-hierarchy relations, mutual-need tensions, control vectors and incentives, relevant social codes, relative social attraction or repulsion dynamics, and competency to coregulate each other without fighting. Although the more aggressive and dominant member of the dyad might choose to displace the more inhibited and submissive member in accordance with the default hierarchy, such activities require energy and are performed with some degree of risk that the subordinate might fight back, especially in situations involving highly valued items. Such fighting might also result in a loss of interactive contact with the defeated subordinate and increased dispersive tensions. These factors appear to add a component of “politics” to the formation and maintenance of power relations. Consequently, in situations where the subordinate might indicate a strong interest in some resource or activity that might be of only moderate or passing interest to the dominant, relinquishing control to the subordinate may be in the dominant’s best interest.

The emergence of bilateral ascendant and descendant social relations organized in accordance with individual control incentives and the dominant’s consent appears to reduce interactive conflict over resources of little value to the dominant but still leaves open a significant risk for disruptive competition to break out over resources of high value to both dominant and subordinate members. In addition to the formation of rigid hierarchy relations around the point of common interest,

some of these conflict situations may be reduced by mutual adherence to emergent social codes (e.g., rule of first possession). Adherence to social codes and rules of fair play appears to help promote friendly relations, harmony, and trust-based bonding. The safe center of the home or living space is defined by secure social and place attachments mediated by mutual attraction and desire to affiliate (affection) in accordance with social codes, fair play, and trust. The safe center is conducive to social engagement, play, mutual appreciation, and interactive harmony. These social codes acknowledge the rights of other group members to comfort and safety and to own and defend personal space and the objects contained within that space conducive to comfort and safety. Group members often (but not always) respect the rights of first possession, especially as regards highly prized items. Social codes appear to develop in the context of give-and-take negotiations and play fighting. For example, puppies learn early on that if they bite too hard or in the wrong place, the play partner will either quit or attack in retaliation. Puppies lacking sufficient play experiences with other puppies often show poor bite inhibition and reactive incompetence toward other dogs and people in adulthood. Interestingly, most socialized puppies show evidence of code-consistent behavior with respect to the site of playful biting directed toward people. Puppies that avidly and persistently bite hands will often switch to licking if presented with the human face. This shift from biting hands to licking the cheek occurs independently of training and appears to represent a canine polymorphic variation conducive to human-dog affectionate bonding. Other puppies show a highly problematic and persistent pattern of periodically jumping at the face and nipping at the nose or around the eyes, perhaps representing a canine polymorphic variation that impedes human-dog affectionate bonding. Face-licking-type and face-nipping puppies appear to express coping styles associated with social dynamics and tensions that tend toward the integration of voluntary and involuntary subordination strategies, respectively.

In contrast to the despotism, involuntary subordination, and dispersive tensions that develop in the context of unilateral power-dominance relations, social interaction guided by pluralistic ascendant and descendent relations tends to promote flexible social relations and voluntary subordination. Bilateral relations and sharing of group resources facilitate cooperative projects and ventures, whereby leader (ascendant) and follower (descendant) roles are determined in accordance with natural talent and skill to accomplish some group-beneficial objective. For example, among wolves, the mother wolf takes the lead in the care and protection of offspring, whereas the father wolf leads hunting and territorial activities. In practical terms, the notion of a *working dog team* is based on a similar balance of bilateral leadership relations and the functional specialization of cooperative roles based on talent and skill. Each member of the working dog team plays obligatory leader or follower roles depending on the needs of the mission and the practical tasks for which the team has been trained. The performance of mission-consistent tasks is called work but is really disciplined play. The process of training integrates a balanced organization of handler-dog ascendant and descendent relations and roles shaped in conformity with the work performed by the team. The handler needs the dog's olfactory sagacity and skill to locate the hidden object of common interest and must defer to the dog's lead in finding it. The dog needs the handler's guidance to ensure that the work succeeds and concludes in play. Only the trainer knows the practical significance of the mission; for the dog, the mission is aimed at securing a common point of interest that denotes activity success and prompts the handler to initiate a bout of vigorous social affirmation and play. The working dog team works to affirm one another's expectations and to celebrate their mutual success by engaging in play.

Social Attraction, Submission, and Pluralistic Agreements

Social dominance is not always and consistently unilateral, but may involve considerable

variation especially among dogs that share a strong mutual attraction, playfulness, and a common set of secure attachments. Instead of forming a unilateral dominant-subordinate relationship, such familial canine dyads may establish complex ascendant or descendant pluralistic relations with one another, depending on the situation involved, individual-need tensions, and control incentives associated with the resource (see *Unilateral, Bilateral, and Pluralistic Relations*). Most dogs sharing a household appear to integrate bilateral pluralistic relations with respect to access to valued resources and group activities, whether a default-hierarchy relationship between them exists or not. The establishment of bilateral ascendant and descendant relations depends on shared expectations and trust that the other will adhere to a code of play fair. According to the pluralistic hypothesis of social organization between canine familial dyads, the agonism between evenly matched competitors is held in check by pragmatic self-interest and trust-related expectancies mediated by give-and-take exchanges and adherence to a principle of fair play. Highly playful and affectionate young dogs establishing attraction-based dyads appear to form relationships that are primarily of a pluralistic nature, since neither of them are willing or are unable to compel the other to submit. In the absence of a default-hierarchy relationship, such dyads may be at an increased risk of certain competitive problems as they grow into adulthood. The most stable social relationship forms in the context of high levels of social attraction and playfulness in which one partner compels the other one, at least once, to yield submission and in turn accepts the submission of the subordinate, reconciles, and forms a harmonious default hierarchy around which to integrate fluid and pluralistic relations.

Interactive conflict around points of common interest varies in accordance with individual-need tensions, control vectors, and control incentives. For some dogs, getting close proximity and attention from the handler is a resource worth seeking, whereas others may be more likely to seek food or other tangible items that they prize. As a result of such motivational differences, control interests converging on social and appetitive resources in the home produce different competitive tensions and potential for striking up aggressive conflict. Pluralistic dynamics between dogs shift depending on the value placed on the convergent point of interest, with one dog taking an ascendant priority of access relative to the other, depending on motivational differences and incentives to control the object or situation. When conflicts emerge in such situations, it is not so much about asserting or testing dominance as it is about laying claim to valued resources and transmitting information about the value that particular resource holds for them. Whereas a resource possessing a high value is reflected in a willingness to invest a significant amount of energy and to take risks to secure it, less valued resources tend to attract a minimal investment of energy or risk taking. In conflict situations over valued resources, dyad members bring different energy-investing and risk-taking strategies (control incentives) to the conflicted situation. The pluralistic hypothesis predicts that there is a greater likelihood that a dog willing to invest only a little energy or take minimal risks to control a resource (dog A) will relinquish control over it to a competitor with whom it has established a default-hierarchy relation and who shows an established willingness to invest more energy and take greater risks to control it (dog B). As a result of such pluralistic competition, dog A will yield ascendant priority to dog B when faced with similar conflict situations in the future, provided that need tensions and control vectors are held approximately constant. The resulting pluralistic agreement serves to reduce interactive conflict around the particular resource, but without affecting the default-hierarchy relationship holding between dog A and dog B; that is, dog A remains dominant and dog B subordinate, even though dog A yields by agreement an ascendant priority of access to the resource held by dog B. The pluralistic strategy is not only conducive to the formation of affiliative ties and loyalty, but provides a way for the dominant to maximize group control over living-space resources in a way that favors those

group members that integrate subordinate relations with it.

Among closely bonded dogs, the avoidance of interactive conflict may also be influenced by a social incentive to optimize affectionate and playful interaction or to preserve cooperative relations and trust by adhering to a principle of fairness. The formation of pluralistic relations allows dogs to compete in relatively peaceful and give-and-take ways over resources that are not unilaterally controlled by the dominant dyad member. The reduction of interactive conflict over resources that are highly valued by both dogs is provided by a unilateral default-hierarchy relation defining a rigid rule of priority to such resources, thereby reducing the risk of fighting in association with scampering contests, for example. Such competition is also controlled by mutual adherence to the rule of first possession. By adhering to the rule of first possession, many potentially competitive situations involving highly valued reward items are effectively decided in advance; that is, the dog that possesses the resource assumes an ascendant priority or claim to the resource that is respected by the other dog, even though the latter has a unilateral claim to the resource. The owner may leverage social control over both dogs by defining occasions (e.g., discriminative stimuli) and rules of access (contingencies of reinforcement) to highly valued social and appetitive resources that are otherwise unavailable for the dogs to compete over. The resulting ascendant and descendant relations between the dogs is managed by the owner to make their interaction and access to owner-controlled resources more orderly, cooperative, and harmonious.

Although pluralistic relations appear to reduce interactive conflict, such flexible agreements of privilege and access priority are vulnerable to changing motivational conditions and cheating. For example, although dog A may ordinarily acknowledge the ascendant priority of dog B to food items, dog A—if sufficiently hungry or attention needy—may cheat dog B by getting to the food item first or by butting in front of dog B for owner attention and claiming rights of first possession—a maneuver that may be perceived as unfair and provocative by dog B. Such events may disrupt the ordinary stability holding between the dogs and precipitate uncertainty or instigate overt animosities and potentially dissolve dyadic hierarchy relations by reducing social attraction and trust and integrating a despotic hierarchy based on fear and avoidance (see *Avoidance Learning and Despotic Hierarchies*). According to this hypothesis, hierarchy relations dissolve when social attraction and trust are insufficient to facilitate (1) submission by the subordinate, (2) acceptance of submission by the dominant, and (3) reconciliation. Assertions of dominance in the absence of social attraction and trust destabilize dyadic relations to heighten interactive conflict, to promote social ambivalence (anger and fear) and avoidance, to instigate dispersive tensions, and, in inescapable domestic situations, to mobilize entrapment dynamics and survival modes conducive to the integration of a reactive coping style and autoprotective adjustments. The necessity of social attraction for facilitating hierarchy relations may ensure that those individuals that enter into the hierarchy bond with the dominant are affectionate and trusting toward the dominant and are received as objects of fondness by the dominant, thereby establishing an organization based on affection and trust conducive to mutual appreciation and harmony, but while serving the self-interests of all involved.

Scrambling Competition

The probability of overt fighting is related to the strength of competing vector momentums set against the relative social competence, mutual affection, and trust exhibited by the dogs. Under conditions of heightened excitability and sudden or unexpected change, the momentum of control vectors may be significantly increased and doubly so for rare or highly valued resources. Although the social codes associated with the rule of first possession are generally conducive to reducing competitive conflict over objects in possession, the rule may also increase control vectors and incentives to reach the object first. Scrambling competition may be particularly problematic

in situations where a highly motivated and quick subordinate may be able to get to objects of interest first that are ordinarily held exclusively by a slower but more aggressive and dominant dog. Under such circumstances, both dogs may escalate competitive tensions under a perceived violation of their right of access and privilege to the item. For example, if two dogs have formed unilateral dominant-subordinate relations with respect to food access, the subordinate is obligated under circumstances of conflict to defer to the dominator, except when the subordinate is in possession of the object or location first. Unlike the relative hierarchy formed in the context of pluralistic relations, unilateral relations promote a rigid dominance hierarchy with respect to certain resources. The rule of first possession conflicts with this rigid determination of access priority and privilege by giving the subordinate special rights in association with items already in its possession, thereby making strategies of first access of adaptive value to subordinates and giving them loop holes for securing control over highly valued items held exclusively by the dominant member. The successful scrambler may also take advantage of owner support, whereby aggressive threats exhibited by the dominant member in association with scrambling contests may be punished by the owner, thereby giving the subordinate an unfair advantage.

Ontogeny of Play and Fighting Among Dogs

Competition between littermates first emerges in the context of relatively symmetrical need tensions blindly propelling them toward the mother's teats. These passive (at first) control vectors enable the puppies to fully exploit the nutritive resources controlled by the mother. Access to the resource (e.g., the most readily available teat) is spatially and temporally determined in such a way that it can accommodate only one puppy body and mouth at a time. Initially, competitive success depends on scrambling success, that is, the ability to get to the teat first. Since the resource cannot be shared, it becomes, at least for the moment, the exclusive possession of the puppy that reaches it first, perhaps prefiguring the rule of first possession. Unlike piglets (Hafez et al., 1962) and kittens (Rosenblatt and Schneirla, 1962), which establish fairly rigid teat orders, puppies do not appear to show such orderly teat preferences but instead persistently "battle for a nipple" (Rheingold, 1963:176). Puppies with the strongest appetitive need tensions are likely to generate the strongest scrambling efforts, thereby enabling them to reach teats first and to stay on them once attached. As a result, these successful scramblers may derive nutritive benefits that support growth and other potential fitness advantages, including an enhanced ability to compete.

Dependency relations between the mother and puppy during the first week or so of life primarily revolve around the regulation of alimentary functions via nursing and tactile stimulation, whereas dependency relations among littermates primarily consist of thermoregulation, mutual orientation toward the mother, and the collective initiation of nursing bouts and sleeping. As a puppy develops, it shows increasing autonomy with respect to its dependency on the mother and littermates. The emergence of social dynamics reflects this developing trend toward autonomy. With increasing autonomy, a puppy learns to relate to the other as a separate entity and forms relations and attachments. The autoregulation of emotional states and impulses is a crucial aspect of the organization of social relations, an adaptive coping style, and secure attachments. In addition to learning how to regulate emotional states and impulses, active rivalry for maternal care and other resources appears to enable rivals to learn how to alloregulate one another through the exchange of various social threat and appeasement displays. However, under adverse conditions, persistent conflict and power-dominance tensions may gradually cause mutual repulsion to exceed social attraction between rivals. Under the strain of competitive tension, where the attraction for local resources exceeds the social attraction between competitors, a pattern of increasing intolerance and agonism may emerge (loner-

dispersal mode), whereby the subordinate is unable to yield submission displays and the dominant (despot) is unable to accept such displays even if they should occur. The result of such interaction is increasing intolerance and avoidance leading to social disintegration. In contrast, under conditions of comfort and safety, social attraction and playfulness will tend to exceed social repulsion gradually transforming competition into cooperation, fear into affectionate submission, avoidance into reconciliation, and despotism into the integration of harmonious pluralistic relations based on fairness and the stabilizing influence of a default hierarchy (see *Unilateral, Bilateral, and Pluralistic Relations*) and a VSS.

Exploitative Competition, Sibling Rivalry, and Emergent Fair Play

The emergence of play fighting between competitors in accordance with a principle of fairness may originate as a secondary adaptation to parent-offspring conflict. Without fair play, competitors would remain conflicted over the sharing of resources and would be constantly in search of taking advantage and getting more at the expense of others via the integration of despotic hierarchy relations. Play serves to transmute competition into cooperation. According to this hypothesis, the gratification associated with play fighting may trace back to the mother-offspring conflict and the associated social attraction/competition conflict emerging between sibling rivals struggling to maximize their share of maternal care. As such, the emergence of play fighting may contribute to the resolution of these primal sources of conflict. Play is a bridge between social attraction and competition mediated by an emergent principle of fairness. According to this hypothesis, the drive to exploit the mother is incorporated into dynamic modal relations consisting of playful exploitative exchanges between sibling rivals (see *Play, Social Engagement, and Fair Play*). The exploitative incentives and advantages taken, given, or denied during play bring the puppies together to play fight arouse precocious sexual, predatory, and fighting sequences that are kept in check by an emergent give-and-take sense of fair play and a shared desire to keep the play activity going. Adhering to fair-play rules and codes enables play partners to get the most out of their mutual exploitation.

Play, Social Engagement, and Fair Play

Competent social engagement skills and tolerance appear to be developmentally dependent on the activation of age-appropriate play activities and the integration of social codes based on fair play. During playful sparring activities, fair-play codes of conduct appear to emerge in the context of give-and-take exchanges controlling aggressive behavior. Puppies learn during bouts of play fighting that, if they exceed a certain limit in how hard they bite or bite in the wrong place, the partner will either yelp and quit playing or retaliate by attacking them. Such give-and-take dynamics appear to have long-term effects on a dog's ability to moderate aggressive behavior and impulsivity in adulthood as well as helping to facilitate the organization of social behavior based on a principle of cooperative fair play. Lund and Vestergaard (1998) traced the appearance of social investigation, play, and agonistic behavior in four litters of dogs consisting of Siberian huskies, English springer spaniels, and mixed breeds. They found that play interactions were closely associated with agonistic behavior, observing that the number of play interactions initiated was closely correlated with the number of agonistic interactions received and, conversely, the number of playful interactions received was closely correlated with the number of agonistic interactions initiated. These findings are consistent with the fair-play hypothesis, whereby playful and agonistic interactions facilitate give-and-take exchanges and the modification of social behavior in accord with a principle of fairness.

During development, the ability to play without fighting gradually results in the integration of stable friendly relations, whereas individuals that cannot play without fighting gradually disperse. The notion that infant social contact and play might help to mediate behavioral changes conducive to social inte-

gration and the moderation of adult impulsivity and aggressiveness has been studied in farm animals and laboratory rodents. For example, Price and Wallach (1990) found that if hand-reared Hereford bulls were denied access to other calves in infancy, in adulthood the bulls showed increased impulsivity and aggressiveness, making them dangerous for caretakers to handle. In contrast, hand-reared bulls that had been allowed to remain in close contact with other calves appeared to learn from an early age to inhibit aggressive impulses in order to avoid the retaliation of others. Similarly, rats deprived of social contact and play early in life exhibit a variety of deficits in their abilities to cope with social challenges (Van den Berg et al., 1999). In particular, rats deprived of early play with conspecifics show a significant impairment in their ability to submit when attacked and to prevent additional attacks by remaining immobile. After social defeat, play-deprived rats appear to go into a disorganizing state of allostatic hyperdrive, showing a higher level of corticosterone and NE than controls. The increased reactivity to social stressors exhibited by play-deprived rat appears to impede their ability to effectively initiate and maintain inhibitory control. Play-deprived rats also appear to be more susceptible to irritability and reactive aggression, showing an increased frequency and magnitude of attacks delivered to cagemates in response to aversive stimulation (Potegal and Einon, 1989).

Model/Rival Theory, Fair Play, and Sibling Hierarchy

The establishment of sibling hierarchy relations appears to be strongly influenced by bystander effects and model/rival dynamics. Observing the relative fighting abilities of littermates may change a bystander's estimation of the rivals' resource-holding potential (Dugatkin, 2001), thereby making it more or less likely for the observer to challenge or defer to the competitors in the future, based on the outcome of the fight. Watching siblings compete over valued objects may play an important role in the way complex hierarchies are formed and social codes inculcated, perhaps serving to reduce the amount of actual fighting needed to stabilize competitive tensions among group members. In addition to bystander effects, some puppies may adopt controlling or yielding roles by modeling the behavior of sibling rivals competing over attractive resources, that is, scripting hierarchy-relevant roles without ever actually competing themselves. Observing that certain interactive scenes regularly trigger overt fighting between littermates may transmit code-relevant information to a bystander that is conducive to fair play and cooperative interaction. For example, the bystander might observe that many fights develop in the context of rights of first possession, perhaps causing it to be less competitive over objects already in a rival's possession in the future. The dog's capacity to incorporate social codes and scripts via model/rival learning appears to be highly developed, and such learning may represent a social cognitive adaptation that has a close functional relationship to social play and the evolution of fairness.

The model/rival hypothesis also predicts that, after observing a fight in earnest between sibling rivals in which a winner and a loser outcome occurs, more inhibited puppies (trait-anxious introverts) will tend to identify with the loser (rival) and adopt loser-scripted roles with respect to the winner and other puppies in the group similarly perceived as possessing a high resource-holding potential. On the other hand, puppies operating under a more confident social orientation (trait-aggressive extraverts) will tend to identify with the winner and adopt winner-scripted roles with respect to the loser and other puppies perceived as subordinate in the group. As the result of model/rival learning, clever and exploitative extraverts might increase social rank and resource control by merely putting on a confident display of winner-scripted role playing, essentially mimicking the attitude and mannerisms of the dominant model. This role-playing strategy might work to obtain significant advantage and social power, at least so long as the actor avoids a competitive scene and contest with the dominant model and thereby risks revealing to bystanders its true resource-holding potential. Interestingly, the

ascendant role player may inherit a default leadership role in situations where an overly aggressive dominator fails to obtain the friendly acceptance of the group. The ability to use dominant signals to achieve rank without fighting and social codes of fair play to maintain social harmony and peace is likely correlated with a high level of intelligence and social adaptability.

FAIR PLAY, EMERGENT SOCIAL CODES, AND CYNOPRAXIS

Species-typical social codes and rules of fair play appear to emerge in the context of play, and some of these canine social codes may not develop in the absence of social or object-mediated play. Social codes and fair-play rules help to regulate potentially disruptive behavior around objects (e.g., rights of first possession) and define how, when, and where coplayers can bite one another. In addition to bite inhibition and rights of first possession, social codes based on a principle of fairness appear to impart numerous other subtle proxemic restrictions on what is allowed and not allowed in play (e.g., ambushing or biting a coplayer that is sleeping). These fair-play codes of social behavior exert a significant influence on how dogs cope with conflict in association with close social interaction and tactile stimulation while organizing and regulating proxemic relations among themselves and people. In general, obvious exploitative or unfair advantages obtained by one partner at the involuntary expense of the other result in the cessation of play or a rapid transition into overt threats or fighting. Whereas survival modes exert broad motivational regulatory control over behavior and mood by altering the significance and reward value of events, social codes appear to regulate complex exchanges and transactions between individuals via the intrinsic reward produced by code-consistent behavior. According to this hypothesis, *code-consistent behavior* facilitates social integration and cooperation, whereas *code-violating behavior* results in social disintegration, competition, and dispersal. Not only play but also many other social behaviors dependent on cooperation appear to be performed in a code-consistent manner. Since the intrinsic reward value of play appears to depend on a mutual adherence to a principle of fairness, emergent code-consistent interaction may also be acquired and maintained via the intrinsic reward associated with the give-and-take exchanges that occur during fair play. The foregoing hypothesis has many interesting implications with regard to the organization of social behavior and the evolution of cooperation. In addition to providing insight into how friendly cooperation and mutual appreciation might develop and contribute to feelings of social comfort and safety, the approach might prove useful with respect to conceptualizing some significant causes of aggressive behavior. The violation of fair-play codes (e.g., cheating or ambush) may trigger a catastrophic loss of trust and a sense of betrayal, and prompt aggressive reprisal or retribution, perhaps in search of something akin to natural justice.

Fair-play Dynamics

Canine social engagement and play depend on the presence of a safe and comfortable environment. The presence of fear or anger rapidly suppresses play and dynamic modal relations (see *Dynamic Modal Relations, Affection, Play, and Bonding* in Chapter 7). The sensitivity of play and social engagement to anxiety suggests that similar cortical pathways probably mediate both play and social engagement. During play activity, facial, motor, and vocal sequences are expressed that superficially resemble flight-or-fight behavior but independently of aggressive or fearful arousal or intent, and instead produce a joyful release of social inhibition. The social exploration and curiosity needed to confidently engage unfamiliar social and environmental stimuli appear to be strongly influenced by social attraction, fearlessness, and an ability to play. A dog's capacity to produce surprise and reward while exploring or playing is coupled with an increased behavioral flexibility to cope with the risk and uncertainty associated with such activities (see Spinka et al., 2001).

Constraints on play activity appear to promote social attentiveness, empathetic appreci-

ation, and compromise. The continuation of play fighting depends on the ability and willingness of play partners to regulate exploitative and power-dominance impulses in accord with a principle of fairness (Bekoff, 2001b) and to participate in a way that keeps the activity fun. To play fairly entails that a dog devote attention to the effects that its actions have on the play behavior of the partner and to adjust its actions in a give-and-take manner to accord with the changes observed. To play well, a dog must possess a rudimentary appreciation of the emotion and covert intent of the play partner and a belief that its actions will affect what the play partner does in return, suggesting the possibility that the dog might possess a rudimentary theory of mind (Horowitz, 2002). During play, dogs take turns in the exchange of gambits and play off one another's actions in kind, thereby setting into action play-mediated pressures conducive to a do-unto-others principle of reciprocation and fairness. Offenses to fair play and slight injuries incurred during play are more likely to incur conciliatory gestures, and such efforts are more likely to be accepted than might be the case following a serious fight. As a result, play may help to mediate tolerance and help to facilitate social skills necessary to reconcile following more serious offenses or injuries.

Although play exchanges and transactions gradually result in a shared construct of fair play, the course of play activities is only loosely determined, and some exchanges will result in mismatches relative to what the individual players might consider fair. Exchanges perceived as more than fair result in an advantage to the player taking them and a disadvantage to the player giving them, whereas exchanges perceived as less than fair result in advantages to the player making them and disadvantages to the player forced to accept them. Imbalances resulting from advantage and disadvantage during play are translated into social attraction and repulsion dynamics and proxemic relations. Learning to give advantages in order to receive advantages or to avoid disadvantages in the context of fair play is hypothesized to prefigure the development of pluralistic ascendant and descendant relations. In general, play exchanges and transactions that are perceived as more than fair are play enhancing (promoting social attraction), but only to the extent that the receiving play partner reciprocates in some way in accord with the principle of fairness. However, if the reciprocation given by the coplayer is not forthcoming or perceived as being less than fair or as selfish, the ultimate effect of the original more-than-fair action will be play diminishing (promoting social repulsion), unless the generous player is strategizing for the sake of some future advantage unknown to the selfish player taking the favors but not returning them. An overly generous player that continues to play despite repeated and unreciprocated sacrifices may gradually become an object of exploitation and aggression. As a rule, both overly generous and overly selfish players introduce discord and hazard into play activity via violations of fair-play codes.

Play and Learning to Cope with Social Uncertainty

Playful transactions involve a considerable element of uncertainty, requiring that coplayers form flexible and friendly expectancies about the other's play behavior and intent. As a result, play appears to promote learning that enables dogs to optimistically appraise and respond to social uncertainty by giving a default benefit of doubt to others. As such, play can be viewed as learning to trust while interacting with others in accord with a principle of fairness, as opposed to the selfish and self-limiting advantages obtained by means of power-dominance struggles. Just as learning to trust entails that one accept and cope with a certain degree of risk and uncertainty, the goal of play is not merely to interact fairly, but to interact in ways that enable coplayers to optimize social advantages gained at the expense of the other in the context of fair-play exchanges. Play appears to enable dogs to confidently navigate through uncertain and unfamiliar social situations under the heightened social attraction and reward afforded by trust. The reward associated with play is hypothesized to serve a cortical training function, enabling dogs to cope better with unex-

pected and uncontrollable stressors associated with domestic life (e.g., startle, strangeness, and uncontrollable events). Consequently, play in combination with the canine antistress system may improve a dog's ability to maintain an adaptive coping style while experiencing social circumstances that might otherwise promote reactive behavior.

Play not only enables dogs to cope with social uncertainty, it may also instruct them on how to use uncertainty purposefully in the context of benign deception strategies. A variety of faking-out, teasing, and deceiving tactics and exchanges are performed in the context of friendly play. Players appear to learn to take advantage of one another by means of teasing and enticing the coplayer rather than by coercing and threatening it. Players increase the momentum of play when they are getting more advantages from the play partner than they expected to receive (surprise) and hesitate or inhibit play when they get fewer advantages than expected (disappointment). Play becomes merely boring when it is just equal or entirely devoid of competitive tension and risk. Despite the momentary ups and downs, the net accumulation of advantages taken and disadvantages incurred during friendly play is generally fair, but with a variance that may slightly favor one of the players at the expense of the other. If the inequities during play are perceived as being too great (unfair), the disadvantaged player may quit or play may precipitously slip into a fighting-in-earnest mode. To avoid some of the pitfalls associated with play fighting, mature players may instruct younger coplayers on how to play fairly by engaging them in object play (e.g., running about holding a long stick in common). If one of the partners pulls too hard, the stick is dislodged from the other's mouth and the fun ends. Tug games may serve a similar instructive function. In addition to object play, a sense of fairness appears to motivate adults and large powerful dogs to handicap themselves to better sustain play with younger or smaller coplayers.

Play, Fairness, and Social Leadership

A dog's propensity to engage, disengage, or confront strange dogs appears to be strongly influenced by social attraction and repulsion, social engagement skills, individual emotional differences affecting reactive thresholds, and cognitive abilities to process subtle social signals. Most dogs show more social attraction than repulsion toward unfamiliar dogs and rapidly approach one another up to a point where repulsion dynamics may cause them to hesitate (conflict distance) and engage in more circumspect and reciprocal social investigations that eventually transition into play. Unlike the extreme behavior of fearlessly obtrusive or power-seeking dogs, most dogs require an introductory phase of mutual investigation before proceeding to more playful or agonistic interaction or disengagement (cutoff). The introductory phase between unfamiliar but friendly dogs is mutually flirtatious and exploratory, consisting of genital investigation and licking. In addition, dogs appear actively and, at times provocatively, to probe one another with sudden fits and starts of activity together with metasignals (e.g., play bow and play face), perhaps to uncover the other's intent, level of irritability, and willingness to play. The play of friendly but unfamiliar dogs is often of a sexual nature. Playful chase-and-evade games, feigned stalk-and-charge sequences, and sparring activities are also frequent and sustained. The playful care seeking and caregiving, competition, sexual exploration, and predatory components may enable dogs to rapidly explore one another and to get on familiar and friendly terms, while stimulating a variety of reward systems conducive to social engagement. Playful sexual behavior may mediate effects akin to pair bonding, whereas caregiving and care-receiving sequences may stimulate maternal/offspring-like bonding processes via the release of oxytocin and prolactin. Predatory-like sequences and reversals may stimulate reward via the activation of the seeking or behavioral approach system (BAS), while play fighting might promote feelings of affiliation and trust. The proxemic scenes and behavioral topographies exhibited by dogs engaged in play may reflect transient states of emotional arousal relevant to the functional system activated by the play activity (e.g., sexual, predatory, and agonistic or power dominance).

When performed in conformity with a principle of fairness and mutual appreciation, these emotional states may synergistically interact to produce a state of joy. However, when activated in the absence of social attraction and fairness, these systems may produce an opposite set of synergistic effects promoting behavior akin to cruelty. Consequently, play in the absence of social attraction and a principle of fairness may quickly transition into exploitation or fighting, resulting in social repulsion and dispersive tensions.

Affectionate proximity seeking and gestures of a friendly nature are common between playful dogs when they are not engaged in play (e.g., gentle facial investigation, sniffing, and licking of the ears). As dogs become familiar and start to integrate friendly relations, they may mutually assert limits on one another, often by the most patient and gentle means, including, if necessary, by direct stare, fang flashing, baring teeth, inhibited nips, and nonbiting snaps or lunge barks. Gradually, a friendly leader-follower bond emerges with the most socially competent, physically active, and confident dogs usually taking a leadership role. Such leaders often show an extraordinary *play drive* and appetite for friendly social interaction. Leaders establish harmony by means of example and adherence to social codes, which includes a fastidious caution with respect to the first law of canine etiquette: the right of first possession. Leaders of this type appear to inspire a subtle form of imitation, submission, and the integration of a voluntary subordination strategy. In contrast, a socially exploitative dog responds to the approach of an familiar dog with a rapid transition to obtrusive play, whereas a socially despotic trait aggressor may stridently approach an unfamiliar dog and compel it to fight. Both of these types violate the principle of fairness necessary for friendly cooperation and play.

Intraspecific State and Trait Aggression

Dogs exhibiting a power-dominance orientation toward unfamiliar males may deliver vigorous and unprovoked attacks based solely on gender and unfamiliarity. As youngsters of 4 to 9 months of age, or occasionally younger, such dogs may suddenly become aggressive and intolerant of close proximity with other dogs—an intolerance that may persist throughout their lives despite intensive positive socialization efforts. The propensity to fight shown by such dogs does not appear to be aimed at integrating hierarchical relations, since trait aggressors will seek a fight with the same dog that the day before was thoroughly intimidated. Many of these dogs appear to operate under the influence of a persistent motivation or drive to fight. A useful term for this sort of agonism is *intraspecific trait aggression*, emphasizing a strong genetic influence predisposing certain dogs to fight. Trait aggression reflects a persistent disposition or temperament trait to experience other dogs as objects to attack. In contrast, dogs exhibiting state aggression fight only to escape or avoid an unconditioned social stimulus evoking frustration or irritation. Whereas state anger is highly emotional and intrinsically aversive, trait anger appears to mediate fighting under the influence of quiet attack and power-dominance motivations (reward incentive). The notion of trait aggression suggests an enduring predisposition to seek out and confront other dogs for the purpose of picking fights, whereas state aggressors fight back or retaliate, exhibiting an unwillingness to submit in response to provocative stimulation (low-fight/high-fear thresholds). Trait aggressors appear to derive reward from fighting, whereas state aggressors obtain reward by avoiding fights (threat display) or fight to escape the fight-evoking situation. The notion that aggression might be rewarding has been recently demonstrated among mice trained to perform an instrumental nose-poke task for the opportunity to attack an intruder for 12 seconds (Fish et al., 2002). These findings suggest that the reward associated with trait aggression may be largely derived from the positive emotions (elation) associated with trait anger and the activation of the BAS (Harmon-Jones, 2003).

Consistent with the intrinsic-reward hypothesis, trait aggressors may develop various strategies to improve the likelihood of

getting an opportunity to fight, and show a preference for locations of past fights. On walks, such dogs may lag behind or, if permitted off leash, they may take advantage of turns or intersections with an apparent hope of putting themselves in a better position to encounter another dog. The trait aggressor may urine mark to attract the marking activity of potential rivals and thereby track their general activity and whereabouts. Urine marks are carefully examined and licked, and surface earth is sometimes slightly upturned while inspecting them. Repeated exposure to the urine odor of a potential target may exert a potent instigating effect on trait aggression. When entering into areas associated with past fighting, trait aggressors often urinate or defecate and then cut deep signature marks into the ground by forceful scratching. Some of these dogs become very stealthy and deceptive, appearing to minimize signs of arousal and intent in order to put the owner at ease before breaking free to attack or lunging and grabbing the other dog and refusing to let go. Trait aggressors live to fight and habitually provoke aggressive interaction with other dogs, irrespective of apparent territorial incentives, appearing to seek aggressive encounters as something akin to a sport activity. Trait aggressors often approach other dogs excitedly with unwavering eye contact and present an inflexible and propped-up appearance that may be misinterpreted as an excited prelude to play. The carriage of the tail expresses social confidence and determination, and trait aggressors usually hold their tails in a stiffly erect position that may quiver and twitch with anticipation. If ignored or not reciprocated with complete submission and obsequiousness, these displays are followed by rapidly escalating threats, including intrusive proximity and contact posturing, an agonistic T orientation, mouthing or nervously licking at the scruff, rising up and mounting actions, and a point of no return. Some trait aggressors show a wide-eyed look of glee (clown face) and an excited tight tail wag just before launching into an attack. Experienced trait aggressors may decide to attack while at considerable distance from the target. In such cases, the aggressor may skip *foreplay* niceties and execute a frontal charge and crash directly into the target, thereby securing an immediate and perhaps devastating advantage. Trait aggressors fight vigorously but appear to maintain emotional composure and often do not bark before attacking.

Many of these dogs seem to be governed by something akin to a chivalrous code that seems to obligate them to fight with other adult male dogs of approximately the same size or larger, whereas they show extremely friendly behavior, bordering on fawning, toward females, with whom they often enact playful courtships. Such dogs appear to fight as though their honor and self-respect depended on it. Trait aggressors are usually gentle and paternal in attitude toward puppies, but are not above serving out harsh punishment to obtrusive juveniles. Although neutered dogs are not immune to attack, in some cases experienced trait aggressors appear to treat them differently, almost as though they did not exist. Some trait aggressors may perceive neutered dogs as being neither male nor female and consequently treat them as nonentities—a feature that suggests a possible gender-specific olfactory trigger or modulatory mechanism controlling such behavior. As they age, trait aggressors typically become less aggressive toward other dogs and seem to retire from fighting altogether in old age. Unlike male aggressors, female aggressors are often equally aggressive toward males and females (see *Virago Syndrome* in Volume 2, Chapter 7). Female aggressors appear to be motivated to fight by different incentives than males (trait/state motivations), showing greater contact intolerance toward other dogs, and, unlike male counterparts, female trait aggressors do not appear to derive the same amount of intrinsic reward from the fighting activity and probably fight for different reasons. Whereas male trait aggressors might be described as fighting for the thrill, female trait aggressors appear to fight for the kill, but are usually satisfied with merely getting rid of the other female. The severity of fighting between females appears to exceed that of comparable males, especially in fighting between dogs sharing the same household. Severe and persistent fighting between females living in the

same home is often motivated by social repulsion and dispersal incentives.

Controlling Intraspecific Aggression Toward Nonfamilial Targets

Unfortunately, owners of dogs that like to fight are often under the influence of denial, refusing to appreciate fully the danger posed by their dog's appetite for fighting. Such owners are prone to offer capricious interpretations and rationalizations to lessen the seriousness of the behavior or to find excuses for it. Many owners appear to treat dog fighting as a normal canine nuisance behavior and are reluctant to seek professional help to control it (Baranyiova et al., 2003). Occasionally, owners may get a vicarious thrill from the dog's eagerness to fight. Such owners may allow a serious problem to develop or intentionally facilitate a dog's propensity to fight. Many owners of aggressive dogs are strikingly irresponsible and permissive with regard to the lackadaisical effort they put into keeping their aggressive dogs under control while in public. Some continue to give their aggressors the liberty to attack other dogs on multiple occasions while in public places. Roll and Unshelm (1997) found that 31% of dogs that fight do so with other dogs known to be targets by the owner in advance of the fight.

All intraspecific aggressors should undergo intensive basic training to tame their aggressive impulses. The goal of remedial training is to promote inhibitory control and introduce countermand signals that reliably interrupt attack-sequence processing and integrate more appropriate ways to cope with the presence of another dog nearby. Large powerful breeds should be exercised on muzzling-type halters attached in combination with a slip collar or a prong and closed-loop leash arrangement, as previously described. As with other cases involving aggression, graduated and massed-trial exposure, response blocking, and inhibitory conditioning can help to reduce reactive behavior and make the dog more immediately responsive to owner command. The following set of procedures assumes that the dog has received intensive preliminary orienting/TAT, thorough basic obedience training, and preliminary inhibitory conditioning.

Aggressive Tensions Around Fence Lines

A common focal point of aggression is fence fighting, which can be a serious problem and cause neighboring dogs to become increasingly agitated and aggressive toward one another. The impulse to fight appears to be intensified by daily instigative exposure to the odor and sight of agonistic targets. Laboratory animals exposed to the sight and smell of opponents but not permitted to fight show a significant increase in aggressive threats and attacks when they are finally free to fight (de Almeida and Miczek, 2002). Whenever possible, fighting dogs that share adjoining yards should be prevented from seeing one another through a fence. Stockade fencing backed with chain-link fencing buried in the ground can be helpful. With aggressive dogs that need to be kenneled in adjoining runs, it is a good idea to divide runs with a 3-foot walkway between enclosures or to separate runs with opaque dividers. Kenneled dogs sometimes break off canines while fence fighting, a significant problem with working dogs whose teeth are needed in working order. Setting up a schedule with neighbors for putting the dogs out separately can be a helpful way to avoid unsupervised encounters between the dogs. Since some dogs appear to develop increased tolerance as the result of graduated exposure, arranging to go for walks with the neighbor and dog can help to reduce tensions. During walks, the dogs should be appropriately restrained and kept far enough apart to minimize aggressive tensions. Both dogs should be discouraged from pulling into the leash and prompted to orient and sit at the least sign of building tensions. Strong emphasis is placed on positive reinforcement, with both dogs receiving vocal encouragement, petting/massage, and food rewards so long as they mind their own business. After returning home, the dogs can be walked along the shared fence line at a nonprovocative distance. Every few steps, both dogs should be prompted to sit or lie down and stay followed by appropriate rewards. If everything goes

well, the owners can initiate object-oriented play activities with the dogs on long lines. When in the yard, performing attention and recall training and playing tug and fetch can help to focus a dog's attention on activities more gratifying than fence fighting. To break up the habit of exiting the house to immediately search for the other dog or scramble to the fence, the dog should receive appropriate inhibitory training around such occasions. Taking the dog outdoors periodically during the day and engaging it in ball play and other basic-training activities can also be helpful.

Dogs showing excessive and persistent aggressive behavior toward other dogs along fence lines should receive intensive recall and halt-stay training, enabling the owner to interrupt the behavior reliably (see *Aggressive Barking, Lunging, and Chasing*). Once a high level of command and countermand control is established, the use of various behavior- and remote-activated devices can be considered, as needed, to enhance inhibitory control over barking excesses and charging at the fence line. The toss of a scented shaker can or jangle of throw rings can be highly effective for interrupting and deterring some fence-related problem behavior, especially in situations where alternative behavior is prompted and rewarded consequent to the startle event. Some electronic devices currently available incorporate both remote and bark-activated capabilities that can be extremely effective when properly introduced. Although electronic training tools are of significant value in such situations, they can also produce significant harm if used improperly. As things progress, various behavior-activated and remote techniques can be applied as appropriate and needed to bring the behavior under more reliable control. For example, in persistent cases, a spray deterrent or electronic containment device might be used to keep the dog away from the fence line.

Attention Control and Gradual Exposure Techniques

Since preattentive processing anticipates the mobilization of arousal leading to aggression, preemptive control is established in advance of a dog showing overt signs of aggressive intent or behavior in order to promote an autonomic state and emotional establishing operations conducive to behavior incompatible with aggression. A conditioned orienting stimulus or a diverter/disrupter may be used to evoke the necessary motivational changes. Diversion with the orienting stimulus or food can be highly effective, if followed by efforts to shape incompatible behavior. If the dog is diverted with food, it is required to perform at least five simple responses (e.g., repeated orienting and eye contact, approach and sit, stand-stay, and so forth) before being allowed to turn back toward the target. Alternatively, a DRO schedule can be implemented whereby the dog is given a reward after some brief period has passed (3 to 5 seconds), provided that it does not show aggression toward the other dog. The delivery of periodic surprise consisting of a highly valued food item (e.g., chunks of chicken, beef, or fish) appears to help integrate new expectancies and to mobilize active modal strategies incompatible with aggression. Access to a rubber toy containing the reward can be very useful in support of DRI and DRO training and for producing a sustained interruption of aggressive arousal and activating appetitive-establishing operations that may antagonize provocative arousal and set the stage to advance the exposure process. The rubber toy is attached to a 6-foot piece of rope with a handle so that toy can be pulled around and the dog enticed to follow and grab it. The dog is permitted to keep the item for a variable length of time to (e.g., 10 seconds to 2 minutes) before it is required to release it to the handler. If the dog barks aggressively or lunges during a DRO cycle, the object is taken from the dog, followed by a right-turn maneuver and directive leash prompt sufficient to secure the dog's attention and to ease the escalating tension, whereupon the dog is hauled off to a post or tree previously set up as a tie-out station. The tie-out should give the dog enough room to stand and sit comfortably but prevent it from lying down during the 30- to 60-second time-out.

In some cases, forced backing can be used in combination with the forward pattern to counteract aggressive arousal. The dog is

trained to walk backward in response to leash prompting and the vocal signal "Back" in a training setting without a target dog. For example, a backing-and-waiting routine can be incorporated into a ritual used when preparing to exit the house for a walk. At such times, if the dog charges impulsively through the door, the leash can be pulled short and pinched in the door jamb, leaving the dog in TO for 30 seconds before trying again. In situations where the dog shows aggressive arousal, it is prompted to back away five steps or so from the target before its attention is diverted with the orienting stimulus and a cycle of DRI or DRO training is initiated. A thoroughly conditioned sit-stay response and orienting/attending response can be extremely useful in such cases. After the dog is prompted to sit, it is periodically prompted with a smooch to make eye contact, followed by the vocal bridge "Good" and a variable or sustained reward. Sustained rewards are provided to the dog by means of sustained petting or massage and several small pieces of food. As the dog shows signs of relaxing, it is walked 5 feet closer to the target and rewarded. If the dog becomes aroused again, though, it is backed off once more from the target, but perhaps more forcefully than before. Whereas forward locomotion is associated with the activation of the seeking system and reward, backward locomotion is mildly aversive and associated with inhibition and retreat. The combination of orienting/TAT, DRI-DRO training, forward-exposure, and backward-exposure procedures with appetitive surprise, and sustained reward, appears to provide complementary modulatory influences over arousal shifts.

Another gradual approach strategy incorporates the starting exercise and basic obedience modules that are first trained to a high level of proficiency, with the dog going to the trainer's left side, sitting, standing, lying down, and staying put until released by the handler (see *Stay Training* in Chapter 1). The dog is started at a nonprovocative distance and turned about to face the target and prompted to sit, rewarded, and released. The starting exercise is repeated over and over again until the dog turns away from the other target, goes to the handler's left side, and sits squarely without hesitation. The dog is then prompted to stand by the handler taking one step forward on the left foot, and again the dog's attention is prompted by means of its name or orienting stimulus (e.g., smooch, squeak, or whistle). Orienting prompts are repeated as the dog is walked at a slow pace toward the target, with the orienting stimulus and click sequence occurring every three to five steps followed by the SE and high-value surprises delivered periodically by hand or tossed to the dog. At the first point in the forward progression in which the dog refuses to yield its attention to the trainer, the handler takes two or three steps back while signaling the dog to the starting position. If dog fails to sit squarely, the handler again steps back and guides the dog into the position. After a moment, the dog is prompted to stand and then to sit, followed by another stand and then prompted to sit and lie down once more. This pattern, consisting of the sit, stand, sit, down, and stand cycle is repeated, with each module of the routine taking 5 seconds to complete, with sustained reward (vocal reassurance, petting, and food), until the distance walked backward is regained in an inchworm fashion. When the original point is reached, the dog is release with an "Okay" and engaged in tug-and-fetch play on leash. If the dog turns from the toy toward the other dog, it is prompted to the starting position by taking two or three steps back and guiding it around. The starting routine is repeated with variations (e.g., left and right approach, interrupting the automatic sit, heeling the dog out of the starting position, and leaving the dog in a sit-stay). Interrupting the dog's attention at the earliest sign of shifting arousal is preferred, but, if arousal escalates at any time into an overt threat (e.g., barking or lunge), a directive prompt or saccade (all-stop procedure) and right-about turn is carried out, whereupon the dog is repositioned at a less provocative distance from the target where the starting exercise with orienting stimulus, bridge, and social and appetitive reward are repeated.

Prompting the dog to orient and repeatedly guiding it into the starting position until

it goes to the position and sits without hesitation can be helpful for integrating inhibitory stop-change control. As the dog begins to sit, the vocal bridging stimulus is delivered, followed by relaxing petting, the presentation of a food reward of significant value, and massage as the dog continues to remain compliant. Inhibitory conditioning is focused on the sit-stay routine rather than punishing overt lunging and threat behavior. In some cases, scented compressed air can be delivered silently, followed by a countermand (e.g., "Stop!" or "Out!") and a brief burst from the modified air pump can effectively grab the dog's attention and generate rapid inhibition without risk of damaging the dog's ears or the ears of bystanders, as might occur with a nautical horn used at close quarters. Exposure to other dogs is carried out under varying conditions and degrees of interactive exposure and risk, as determined to be appropriate, safe, and most likely to succeed. Exposure is best mediated in the context of practicing a variety of basic obedience exercises on a 6-foot leash and later graduating to long-line control. Muzzling should be considered for the sake of public safety in the case of a dog that represents a significant threat to other dogs and people, at least until the handler has acquired the necessary skills and experience to interrupt and reliably control the dog's aggressive behavior whenever and wherever it occurs.

Since many aggressors appear to derive significant gratification from the opportunity to fight, appetitive counterconditioning and reward-based shaping procedures are of limited value, especially for dogs that would place the opportunity to fight above the acquisition of social attention, food, and play. Persistent aggression toward other dogs not belonging to the household can also be brought under stimulus control by training the dog to turn on and turn off aggressive arousal and threat displays. This particular procedure is especially useful with trait aggressors. However, before implementing such a procedure, serious consideration needs to be given to the owner's dog sense and dedication, because the approach, if improperly implemented without appropriate inhibitory control, may only make the problem worse. Controlling trait aggression depends on rapid decisions and actions in response to the earliest signs of aggression. For effective control, directive and saccadic prompts need to be delivered with sufficient conviction and strength to bring the developing attack sequence to a dead halt. The application of preemptive prompts in anticipation of aggressive arousal can be highly effective for establishing inhibitory control. These general control requirements can be expedited by electronic training (see *Electronic Training and Problem Solving* in Chapter 9). The electronic collar is introduced in the context of reward-based training and only after basic modules and routines have been well conditioned. Enhanced attention control, recall, halt-stay, and sit-stay and down-stay training are emphasized. The dog is gradually exposed to other dogs in incremental steps, and sequences similar to the procedures and variations are used to stage exposure, as previously described (see *Aggressive Barking, Lunging, and Chasing*). The exposure procedure can be highly effective when performed in association with electronic training for mediating avoidance control over aggressive impulses. In addition to mediating avoidance learning and improving inhibitory control, the electrical stimulus may help to offset intrinsic reward derived from the dog fighting activity.

FIGHTING BETWEEN DOGS SHARING THE SAME HOUSEHOLD

Preliminary Considerations

Assessing and controlling fighting between resident dogs is multifaceted (see *Aggression Between Dogs Sharing the Same Household* in Volume 2, Chapter 7). The first step in the process is to assess the frequency and severity of past incidents. In addition to obtaining detailed information about the specifics (e.g., eliciting triggers and situations), a summary of injuries to the dogs should be obtained as well as injuries to people that resulted from redirected aggression or accidental bites that occurred while fighting dogs were being separated. Since interdog aggression may occasionally stem from increased irritability and

mood changes resulting from an undiagnosed medical condition, it is important to collect information about the dog's health and recommend that a veterinary examination be performed to exclude such potential factors. In cases involving damaging fights that have resulted in significant injury, various strategies for keeping the dogs apart should be discussed and implemented, including the possibility of rehoming one of the dogs. Sturdy gates, tie-out stations, and crates can be useful in the management and training of such dogs. The trainer should thoroughly explore the risks involved to the dogs, as well as risks of injury to family members that can stem from redirected attacks, or accidental bites that might occur if someone attempts to separate the dogs while fighting. Finally, in some cases, what appears to be fighting to a novice owner is actually just play (Figure 8.4).

Ability and Readiness to Fight

Dogs appear to rapidly appraise each other's relative ability and readiness to fight, referred to as *resource-holding potential.* Resource-holding potential is often correlated with size but is also strongly influenced by need tensions and control incentives, that is, the individual's determination to establish control over a contested resource or place. A small but highly motivated dog can defend a valued object against a much larger but less motivated challenger. The effects of past victories and defeats appear to influence significantly the dog's readiness to fight, perhaps by switching on or off neuroendocrine modes conducive to confrontation or retreat behavior. Perhaps the most important considerations affecting resource-holding potential are prior residency and age. Age and prior residence appear to confer special advantages and expectations with respect to privilege and governance rights. Newly introduced young dogs appear to defer as obligatory subordi-

FIG. 8.4. From appearances, these dogs look as though they are fighting with some degree of seriousness, but actually they are playing and have never fought in earnest to inflict or defend against injury.

nates to the most original resident of the home or living space, which is often the oldest dog in the group. The implication of age in the organization of hierarchy may stem from increased experience and prior use of the home range. Established residency appears to imply ownership and control over the entire living space, at least as regards canine interests.

To form secure social and place attachments, the newcomer must enter into pluralistic relations with the resident, but, to achieve this level of social integration, the resident and the newcomer must share mutual social attraction that is sufficient to integrate dyadic hierarchy relations. As such, social attraction and repulsion are the most primary modes of social grouping or dispersion. The ease with which males and females integrate social relations and tolerate the introduction of a nonrelated puppy is probably based on attractive preferences shown toward the opposite sex and a readiness to integrate young animals into the familiar social structure. In addition to residency, social status is broadcast by a dog's attitude, with the most conspicuous and consistently reliable indicator of relative dominance represented in the way in which the dog carries itself—not its size or physical strength. A feisty 10-pound dynamo with *attitude* can challenge and roundly subordinate other dogs many times its size as though it were perfectly natural and correct, especially if it is older and holds privileges of prior residency. However, the ultimate determinants of dominant or subordinate status are closely related to temperament differences, especially relative fearlessness, excitability, and aggression thresholds. Holding other variables constant, dogs that are relatively shy and inhibited are typically more likely to avoid confrontation and to back down if confronted, whereas dogs that are relatively bold, excitable, possessive, and prone to aggressive impulsivity are more likely to confront other dogs and fight if confronted.

Stake-and-Circle Test

If uncertain about an adult dog's propensity for fighting, a potentially useful way to evaluate relative dominance and social tolerance is a modified stake-and-circle test, which is based on a procedure devised by Le Boeuf (1967) to evaluate interindividual relations between dogs. The test situation used by Le Boeuf consisted of a stake and 5-foot chain and harness attached to one dog and a large arena that allowed the other dog to rove about freely. Approach behavior was quantified by counting the number of times that the roving dogs made contact with tethered ones and the amount of time they spent in close proximity (i.e., remained within the circle defined by the chain). Dogs did not appear to become more aggressive when tethered; in fact, roving male dogs initiated most of the aggressive encounters, with the tethered dogs fighting back or submitting. Agonistic encounters between the most aggressive dogs usually ended before escalating into overt fighting, with neither of the dogs submitting or reducing their animosity or willingness to fight in the future. Interestingly, the dogs that spent the most time visiting tethered dogs were also least likely to receive visits from other dogs when they were tethered. The dogs making the most frequent approaches to tethered dogs were typically more outgoing, fearless, and aggressive. These more socially outgoing and aggressive dogs appeared to establish friendly alliances and cohort relationships with certain submissive dogs toward which they showed little or no aggression. The most aggressive males initiated more visits to other dogs irrespective of past encounters. In contrast, males rarely approached other dogs that had previously defeated them. Whenever the most aggressive and fearless dogs came together, they consistently showed mutual hostility. More aggressive dogs appear to approach other dogs more frequently because the former are less fearful. The relative fearlessness or boldness of such dogs may account for their inability to establish dominance over one another. These results suggest that the stake-and-circle test might reveal individual differences associated with extraversion and social dominance.

A variation of the stake-and-circle test is performed by alternately tethering one dog (T) on a 5-foot line or cable and allowing the

other dog (R) to rove about on a 30-foot long line that is tied off at a point that allows R to reach within 2 feet of T. Roving dogs with a bold disposition will tend to approach tethered dogs rapidly, irrespective of their relative boldness or shyness, whereas dogs with a more shy disposition will tend to avoid approaching other dogs perceived as a threat. Dogs showing aggression in association with autoprotective incentives may show preemptive threats toward the approach of a roving dog but avoid the same dog when it is tethered. The basic test is performed with the owner at the midway point between the roving dog and tethered dog. In addition, two subtests are used to evaluate the influence of the owner's presence on aggression tensions. Subtest 1 is performed with the owner positioned to the right or left of the tethered dog at a point that is just out of reach of both the roving and tethered dogs. Subtest 2 is performed with the owner positioned within the reach of the tethered dog and making an excited and affectionate fuss over it as the roving dog is released. Subtest 3 is the same as subtest 2 except that, as soon as the roving dog is released, the owner immediately withdraws from the tethered dog and approaches the roving dog and makes an excited show of affectionate attention just out of the tethered dog's reach. After 30 seconds, the owner abruptly stops and returns to the tethered dog. Relatively fearful and submissive dogs may be emboldened by the presence of the owner to approach closer than they normally would, perhaps triggering animosities, whereas more aggressive and socially intolerant dogs may show heightened animosity when approached in close association with the owner.

Sources of Conflict Between a Newcomer Puppy and a Resident Dog

When bringing a new puppy into the home, many dog owners are apprehensive about how the resident dog will react to the newcomer. Although the pattern of coping is variable, most dogs gradually learn to accept and enjoy the new addition to the household. Adult dogs rarely attack a puppy to injure it, but may set limits with a severity and force that may seem excessive and inappropriate to the dog owner. Canine behavior toward puppies appears to be governed by a social code that forbids injurious bites or life-threatening attacks. Dogs that violate this social code are truly abnormal and should not be in the same household with a young puppy.

Although serious attacks are rare, irritability and intolerance toward a puppy are common. The way a dog copes with a puppy is determined by numerous developmental, experiential, and health variables. For example, due to age-related differences affecting playfulness or physical condition, older dogs are often less engaging and tolerant than are younger dogs. Highly active and intrusive puppies can be a source of significant distress for elderly dogs. Typically, a socially competent dog will rapidly establish appropriate limits and integrate social relations with the puppy that develop into a secure attachment and mutual attunement. Inhibited or insecure dogs may allow the puppy to violate normal canine boundaries with impunity and, instead of punishing it, may do everything possible to avoid it. As a result of persistent exposure to an inescapable puppy, insecure dogs may resort to compulsive barking or other rituals whenever forced into intimate contact with the newcomer. In such cases, nothing that the puppy can do will change the situation or make the insecure dog more accepting. Initially, owners may misinterpret the obtrusive play behavior of the puppy and the apparent acceptance shown by the insecure dog as an indicator of forbearance and gentleness, but the withholding of social punishment (limit-setting actions) in such cases is more often a sign that the dog has refused to accept the puppy, perhaps refusing to acknowledge its existence by passively disengaging. Further, puppy play unconstrained by fair-play limits may rapidly degrade into exploitative cruelty, whereas indiscriminate punishment of friendly social engagement and play by an overly reactive dog promotes social repulsion, dispersive tensions, and a nervous attachment. In contrast, nervous dogs may punish a puppy whenever it comes too close. Punish-

ment, as delivered by nervous dogs, is not aimed at educing submission or integrating hierarchical relations—its only purpose is to keep the puppy at a distance. Allowing a bold puppy to take advantage of an overly tolerant and insecure dog, or allowing the puppy to fall victim repeatedly to the threats and snaps of an intolerant and nervous one, may permanently prime social exchanges with reactive dynamics and expectancies. All of these problematic responses to the introduction of a puppy are related to a common denominator: insufficient autonomic balance and social attraction to initiate and sustain friendly interaction.

How a dog responds is strongly determined by the nature of already established social and place attachments. Whereas dogs under the autonomic attunement of secure place and social attachments tend to show an adaptive coping style that promotes attentive and calibrated emotional engagement (inquisitive boldness), dogs expressing nervous or insecure attachments exhibit various deficits and deficiencies that impair their ability to cope with the social demands posed by a puppy. Whereas the nervous dog lacks sufficient stability to establish social relations, the insecure dog lacks sufficient flexibility to integrate new social relations. The reactive instability and rigidity of nervous and insecure types represent significant challenges when a new puppy is introduced.

The critical issue at stake when introducing a puppy is to provide social and environmental incentives that promote mutual attraction and attachment. Outdoor activities, involving walks, play, and reward-based training activities, may serve to link the puppy with a positive QOL-index shift, thereby helping to activate survival modes conducive to social integration. The perception of an improved QOL index can be amplified by increasing the number and variety of appetitive and social rewards given to the dog during the day, both in the puppy's presence and at other times. Improving the quality the dog's diet by making small changes (adding favorite food items), or just allowing the dog to eat a small portion of puppy food at every feeding, can make a difference in how the dog perceives the new situation. In contrast, however, isolating the dog or reducing its access to valued rewards may have an adverse effect on its ability to integrate affectionate relations.

In general, the relationship between the puppy and the dog is one of imbalance on practically every level. Significantly, a puppy is far more interested in attaining the regulation provided by attachment than a dog is in giving it. From the dog's perspective, the puppy is a disruptive influence over well-established relations and attachments between the dog and the household. The owner should be encouraged not to become overly involved or attempt to micromanage the transition. Ultimately, the goal is to facilitate and foster interaction rather than attempt to dictate a relationship that depends on the owner's constant supervision to work. Generally, giving the resident dog support and the benefit of doubt in its efforts to curb the youngster's excessive behavior is beneficial. Owners who side with the puppy risk establishing a highly undesirable alliance and misperception that can exert long-term destabilizing effects. Instead of forming bonds with each other, such dogs may establish triangulated relations via the meddling owner. As a result, the puppy may become increasingly obtrusive toward the dog when in the owner's presence, with the latter becoming increasingly insecure, irritated, and intolerant of contact with the puppy.

Since social attraction is a necessary precondition for a dog to accept a puppy, owner interference may effectively block the integration of hierarchical relations. The primacy of social attraction, reconciliation rituals, and social engagement for organizing harmonious relations cannot be overemphasized. A dog that continues to avoid the puppy and treats it as a source of loss, irritation, and intolerance may become increasingly repulsed by its approach, showing a rigid and reactive pattern of avoidance and threats. As the puppy matures, it may become increasing bold and reckless in its interactions with the reactive dog. As a result of owner efforts to splice together a relationship in the absence of social attraction, the dogs may become increasingly defensive and autoprotective whenever in the

presence of the owner, until they cannot be in the same room together without restraint. Attempting to integrate dyadic relations between dogs lacking social attraction is difficult, but integrating such relations between dogs that are mutually repulsed and intolerant is often impractical and raises many QOL and welfare questions.

Introducing a New Adult Dog into the Household

Whenever introducing adult dogs, efforts should be taken to set things up for success and not to take unnecessary risks and shortcuts that might result in a fight. A fight during the introduction leaves a very durable and, perhaps, insurmountable first impression. Consequently, great care should be taken to ensure that the first encounter is as positive and uneventful as possible. Organizing the first meeting to take place in a transitional location where the resident dog is accustomed to meet strange dogs and has been exposed to a history of playful interaction with them is a useful starting point. Alternatively, arranging to take the dogs on a long walk together can be a relatively nonprovocative way to break the ice. If tensions erupt, various reward-based attention-control techniques can be helpful. Taking turns with each dog to play ball while the other looks on seems to reduce tensions while priming the dogs with arousal more conducive to positive social interaction. If animosities emerge despite precautions, an appropriate assertion of control at the instant they begin to percolate can prevent escalation and reduce the risk of reaching a flash point of no return. If necessary, a directive leash prompt is used to restore control and order before continuing the walk as though nothing had occurred. Evenhanded and decisive interruption of argumentative exchanges can help to deflate competitive tensions and make it easier for the dogs to engage in less provocative exchanges and to promote conversations conducive to mutual tolerance and eventually acceptance. The goal of the introduction is to mediate increasing familiarity to set the stage to allow sufficient social attraction to develop between the dogs to generate play. Without adequate preliminary safe interaction to mediate familiarity, an atmosphere of mutual uncertainty may block the emergence of social attraction and increase the risk of a fight breaking out instead of play. Fighting between unfamiliar dogs is not conducive to the integration of dominant-subordinate relations based on submission, but instead results in social polarization, mutual intolerance, or persistent aggressive tensions. Between strangers, the exchange of threats will either increase mutual anger and trigger fighting or increase fear in one of the competitors, thereby setting the stage for flight and persistent avoidance.

Unfortunately, due to hesitation or lack of appropriate control over the dogs, inexperienced dog owners may hesitate at the critical moment and allow the tensions to escalate and erupt into a serious fight. The owner may subsequently become increasing uneasy and nervous with the dogs interacting nearby, especially at times and places associated with increased excitement (e.g., homecomings, preparations for walks, and feeding times) and previous fighting. These various times and places may acquire conditioned associations that trigger preparatory arousal and lead to an increased risk of fighting whenever the dogs encounter each other under those evocative circumstances. These exciting situations appear to simultaneously disinhibit the dogs in anticipation of a rewarding activity with them together, but, as they interact in the close vicinity of the owner, the exciting arousal drawing them together may dissipate as overshadowed fear and anger gradually take front stage. Under these circumstances, owner anxiety may add an additional element of uncertainty to further destabilize the rapidly escalating conflict. Dogs probably do not process owner anxiety egocentrically, but are more likely to associate the changes in the owner's behavior allocentrically, that is, attribute its cause to the other dog. As a result, a possibility exists that both dogs may cross-attribute the owner's anxiety to each other. Determining specifically how different human mood states influence dog behavior is an important area of basic research that remains to be worked out in detail, but anxiety-related changes to the owner's olfactory signature

may play a role. Whereas negative owner mood states under such situations are probably processed allocentrically, positive changes in owner mood states are probably processed egocentrically. Thus, maintaining a positive and confident mood may result in helping both dogs to relax and become less ambivalent or reactive toward each other while in the owner's presence. Conversely, a worried owner may cause the dogs to interpret the situation as unsafe as the result of causes due to the other dog, thereby increasing mutual vigilance, agitation, intolerance, and the readiness for the dogs to fight. Although the precise details of the signaling system mediating these changes remain to be studied, the composite of conditioned stimuli, contextual cues, and owner anticipatory-anxiety signals may establish a hierarchy of trigger events that lead to increasing reactive arousal and set the occasion for fighting. Unquestionably, owner inexperience and lack of dog sense and training skill in such matters is a significant factor in the development of interdog aggression (see Rugbjerg et al., 2003).

Aggression between such dogs is not likely the result of dominance, as it is a conditioned behavior mediated by history of fighting and owner mismanagement. Under the influence of repeated and ineffectual interference, the resident dog may gradually turn on the newcomer at the least provocation. What began as relatively infrequent and innocuous scraps may develop into a frequent and serious pattern of injurious fighting (Figure 8.5). It is interesting to note that such dogs may not fight when left alone, but this cannot be relied on in every case, especially where a high degree of interactive tension and rejection is present and where damaging fights have occurred in the past. Further, once fighting has escalated to include damaging bouts, then the option to allow the dogs to fight is neither effective nor humane. To reiterate, once tensions have graduated beyond the level of ritual contests, staging tournaments between the dogs in order that one of them might finally win decisively and become dominant over the other is not a viable treatment option and could result in one of the dogs being severely injured or killed. Dogs operating under strong repulsion incentives and entrapment are not fighting to integrate hierarchy relations but instead may only be satisfied after the other is gone or dead.

In an important sense, submission is a social distance-decreasing activity occurring within the vertical hierarchy dimension. This is interesting because hierarchy is based on the formation of social distance-increasing relations. Submission appears to ease vertical social tensions, reflecting the involvement of social attraction in integrating harmonious

Fig. 8.5. Fighting between dogs sharing the same household can be serious, with females showing a greater risk for such problems than males. Breed-specific tendencies may exert a predisposing influence. Even after several years of tolerant interaction, increased tension, flare-ups, and overt fights may break out. The injuries can be significant and costly. The Akita pictured lived with another female with whom she shared the house for several years. Both dogs sustained numerous lacerations and punctures to front legs, shoulders, and the neck.

social relations. Submission by the newcomer and reciprocated tolerance shown by the resident dog is a form of social reconciliation and fairness enabling the dogs to build a friendly relationship. Submission rituals, social attraction, and trust based on fair play appear to give rise to pluralistic ascendant and descendant relations organized around a default dominant-subordinate relationship formed between the resident dog and the newcomer. In the case of puppies and young dogs, friendly dynamics and trust are facilitated by the concentrated exchange of numerous playful transactions in accord with a principle of fairness. The number of transactions taking place during a play bout may correlate with a mutual motivation to integrate friendly relations, that is, provide a social attraction-repulsion index. During an average play bout, dozens of fair-play exchanges may take place in comparison to a mere handful of fair exchanges that might take place during the course of an average day. According to this hypothesis, what might be achieved in terms of social integration following one or two bouts of play might take weeks or months to achieve in the absence of play, if at all. The surprises and joy generated by energetic interaction with a fair coplayer may be cathected to the coplayer as an object of affection and pleasure, thereby increasing attraction and antagonizing social emotions incompatible with social integration. In addition, object-mediated play between the handler and the dogs can be used to facilitate improved inhibitory control via the command and countermand regulation (e.g., go/no go and all-stop inhibitory exercises) over object-chase sequences involving prized toys and throw-away items.

Interdog Aggression Within the Household

Because of the obvious dangers involved, dogs sharing the same home that fight are frequently isolated from one another. Although separation is an important precaution to take when the dogs are left alone, constant isolation in different parts of the home is not a solution and does not appear to improve their chances of restoring trust. Social isolation is often convenient and may be a useful measure to prevent fights for the short term, but as a long-term arrangement separating the dogs may only serve to increase estrangement, torque up aggressive tensions, and generally worsen the situation. Eventually, someone will forget or lose track of their whereabouts and allow the dogs to get together. If a decision is made to keep such dogs in the household—which is not always practical or wise—then both dogs should receive intensive basic obedience training, graduated exposure and response blocking, counterconditioning, and appropriate inhibitory conditioning (e.g., go/no-go, stop-change, and all-stop procedures) to reduce aggressive tensions and improve the owner's ability to interrupt escalating tensions before they reach the flash point of no return. Fighting that breaks out at times of increased excitement (e.g., owner homecomings, feeding times, and before opportunities to go outside) often benefit from intensive wait (go/no-go) and delay-of-gratification training. Building a virtue around waiting and taking turns to obtain attention, affection, and other rewards by following rules can be very helpful.

Training Recommendations

The assumption that dogs fight because of a failure to form a dominance hierarchy has led to a widespread practice of treating such problems by having the owner leverage one dog into a dominant role and the other into a subordinate role by means of owner-controlled rewards and preferential alliances. Whether such brokering strategies exert a significant effect on dominance relations has not been demonstrated in dogs; one might assume, however, that such recommendations are not likely to provide much help with dogs lacking social attraction. In the absence of social attraction, it is unlikely that dogs can submit (subordinate) or to accept submission (dominant) while forming conciliatory proxemic relations. Further, despite the appearance of being ethologically sensible, the hypothesis requires a considerable leap of faith to assume that coherent and stable dom-

inant-subordinate relations might be telegraphed by means of owner leveraging and refereeing. Stable dominance relations appear to be dyadic in nature, requiring that one dog, the dominant, assert dominance and, in turn, accept submission from another dog, the subordinate, in order for them to integrate a friendly relationship. If the dominant dog fails to compel the subordinate to submit or is unwilling to accept the subordinate's offer of submission, there is no hierarchy relationship integrated between them. Training procedures aimed at integrating a social hierarchy by means of proxy seem especially problematic and ill-fated for dogs operating under the influence of mutual repulsion and dispersive tensions. In general, attempting to integrate power and hierarchy relations in the absence of mutual attraction results in social ambivalence (anxiety and distrust) and an ISS, whereas the integration of hierarchy relations under the influence of mutual attraction promotes affection, trust, and a VSS. According to this perspective, it is not only futile to establish hierarchy relations between dogs that are repulsed by one another, such efforts may actually worsen the situation. Instead of worry about which dog is dominant or not, the focus of training should be to leverage owner control over both dogs in a way that facilitates voluntary subordination and engenders confidence that the owner has the situation in hand. A strong and evenhanded owner presence provides a sense of security that may help the dogs to relax and feel safe, and thereby facilitates the activation of the SES.

To enhance owner control, both dogs are kept on leash at all times when under supervision. In all potentially provocative situations, efforts are taken to mediate nonprovocative access and sharing of appetitive and social rewards in a pluralistic way that supports cooperation and acknowledges social codes based on fair play, mutual attraction, and adherence to owner rules. The right of first possession is especially important with regard to competitive situations developing around attention-seeking behavior toward the owner, especially in situations where fighting has broken out in association with such activities in the past. Socially intolerant dogs that engage in excited jostling for proximity with the owner during greeting frenzies may incidentally enter proxemic zones inappropriate to their level of social attraction and as a result trigger a rapid escalation of arousal, possibly setting off an all-out fight. To prevent such situations in the future, precautions need to be taken to prevent close contact between the dogs during greetings, at least until they have integrated more friendly relations. During greetings, and at other times as well, interaction between the owner and dogs is formalized with rules of access that the owner dictates without respect to the rank of the dogs. Both dogs are discouraged from crowding and jostling with each other for owner attention. The owner should become a source of social control and order rather than attempt to broker dominant status or play the role of a referee between the dogs.

When left alone, such dogs should be separated, perhaps by keeping them in crates. Upon entering the house, the owner should give the dogs a few minutes to calm down before greeting them one by one. During such homecoming activities, the dogs are both put through a series of basic obedience modules and routines until attention and impulse control are fully established. The focus of work is directed toward establishing limits on pulling and stay/wait training. If warranted for safety purposes, the first dog is restrained at a tie-out station, while the second dog is leashed and greeted in a similar fashion. Dogs that exhibit tensions around feeding should be fed in separate rooms or crates. During food preparations, the dogs can be placed in separate rooms, crates, or tethered, where they should remain until both have finished eating and the food bowls have been taken up. When going outdoors for walks or coming back inside the house, the owner should determine the order of egress. Since squabbles and fights often develop around transition points involving excitement, the rules and rights of egression should be the focus of significant training and inhibitory conditioning until both dogs have learned to "Wait" and "Back" on signal. When giving treats or toys, the owner should determine which dog gets its share first, not based on a perception of

rank but based on compliance to command. If aggression tensions have occurred on furniture or beds, both dogs should be trained to stay off such items, unless invited up, and to obey rapidly when prompted to get off.

Dogs with fighting problems should receive intensive attention and impulse-control training, ICT, and inhibitory conditioning using the procedures previously described in Part 1, with both dogs learning to defer without hesitation to owner demands and directives. When agonistic tensions escalate and necessitate intervention, the owner should establish control without taking sides or worrying too much about which dog is dominant or how the limit-setting actions in the present might affect dominance relations between the dogs later. Social dominance is of little consequence in the beginning and, in any case, hierarchy relations will naturally take shape as social attraction and trust build between the dogs. If the dogs cannot tolerate being in the same room with each other, dominance relations are moot. In the long run, the social status of the dogs is far less important than preventing fights and providing a social space for promoting social attraction. Dogs given a sufficient number of safe opportunities to interact with each other may gradually acquire the necessary social attraction, confidence, and trust needed to integrate friendly relations. However, dogs that are pressured to integrate hierarchical relations in the absence of social attraction will only become progressively avoidant, intolerant, and reactive. When dogs possess adequate social attraction to give and accept submission, the establishment of default hierarchy relations naturally follows without much consequence. Only when the relationship is conflicted with repulsion and entrapment dynamics does dominance become a central point of concern and tension.

A social space conducive to social attraction and friendly interaction is established by setting limits on intrusive behavior and provocative exchanges. The training of an effective all-stop inhibitory response is of immense utility for controlling dogs in such situations. Both dogs are required to defer to the same basic imperative: fighting is not an option. Since fighting will only serve to sharpen animosities and promote social repulsion, when a fight is in the suspense phase every effort is applied to exert decisive inhibitory control, leaving no doubt or wiggle room concerning the handler's position on the matter. Nagging reprimands, ineffectual leash grabbing, fussing, and bribing will only ripen the problem, whereas an appropriately firm reprimand originating from the belly and delivered with force, a directive or saccadic leash prompt, or a brief electrical pulse can effectively interrupt and discourage the escalation of such behavior. Electrical training procedures can be useful for interrupting the preparatory phase, but once a fight has commenced, the use of electrical stimulation may only intensify reactive arousal and potentially worsen the problem. The goal is to take control and prevent the fight, not to referee or direct the ongoing drama and suspense between the dogs. The idea is to end fighting, not to explore dominance theories. Since the owner is more likely to possess sufficient social attraction to integrate a dyadic hierarchy with the dogs, it is the owner's dominance that most needs clarification in the process of establishing limits and order conducive to friendly relations between the dogs. A strong and fair owner presence appears to go a long way toward decreasing agonistic tensions between dogs, perhaps by helping them to feel safer while in the owner's presence and by using their attraction toward the owner to integrate submissive behavior and enhanced impulse control.

Transitional situations that stimulate a high level of excitement (e.g., going through doors) are particularly risky. In addition to taking steps to reduce excitement at such times, basic training and inhibitory conditioning are performed to establish and enforce appropriate rules and behaviors to reduce competitive tensions and to keep the dogs apart. Both dogs need to regulate interactive exchanges around valued resources and activities in accordance with a "first come, first serve" rule, to actively defer to the owner's directive authority, and to exercise preemptive restraint over aggressive impulses. Along with reward-based procedures, time-out offers a

means both to discourage inappropriate behavior and to reduce autonomic arousal and excitability. Anticipatory agonistic arousal and intention behaviors should be carefully monitored and diverted or disrupted before they intensify into overt threats. Prompting competitors to perform basic obedience modules and routines while in the presence of each other may be beneficial. Such activities provide a structure of rewards and owner approval conducive to cooperative interaction and fairness that may help to reduce agonistic tensions. The interactive benefits of such training may be especially beneficial if the response of the worker results in a reward matching the standard expectancy (SE) while the observer is given a reward that exceeds the SE for merely being present and not interfering. Alternatively, having the worker perform some basic exercise, but giving the immediate reward matching the SE to the observer and then giving the worker a reward exceeding the SE (surprise), may also promote constructive dynamics. Variations on this plan include surprises for the observer that result from interaction between the owner and the worker. For example, after prompting the newcomer to sit or lie down, the observer is prompted to orient by smooch or squeak, whereupon the orienting response is immediately bridged and the dog tossed a reward. Every so often, a surprise (high-quality reward or toy) is delivered, perhaps in association with showing added attention to the worker in the context of object-mediated play. The observer should be tethered in the beginning but can become increasing involved by means of an active-control line.

Organizing training activities so that surprise is arranged to occur as the result of cooperative interaction in various social situations can help to facilitate social exploratory behavior and mutual tolerance and possibly set the stage for play. The goal is to teach the dogs to take turns and to cooperate in order to avoid inappropriate contact and aggressive arousal. Training both dogs to walk on leash without pulling promotes a number of significant benefits mediating positive change. For example, walking appears to exert a potent stress-reducing and counterconditioning effect, in addition to stimulating beneficial allelomimetic associations that may create a sense of pack affiliation. Walks, especially those in which the owner imposes effective limits on pulling, a rule that is fastidiously enforced, may enhance the dogs' perception of the owner as a source of control and order. Initially, the dogs may need to be controlled by separate handlers, but as things progress the owner should be able to walk the dogs in brace (not coupled), as appropriate and safe. During controlled walks, orienting responses, quick-sits, and sit-stays or down-stays should be frequently practiced and rewarded.

Preventing and Breaking Up a Dogfight

Breaking up dogfights is fraught with dangers. The catastrophic arousal supporting combative behavior is the result of an avalanche of neurobiological events that may precipitously lower aggression thresholds in response to interference and restraint, causing fighting dogs to redirect hard snaps toward anyone that may foolishly attempt to stand between them. Owners enacting a referee role toward evenly matched dogs seem to be particularly prone to this error in judgment during a fight, perhaps stemming in part from a perceived loss of authority that they may feel obliged to regain or as the result of a fear that the dogs will seriously injure one another. However, going up against claws and sharp teeth with soft human skin and bravado is not an action that either dog would likely expect from the brightest member of the pack. It is especially risky to reach for the head or neck of fighting dogs, since such sites are typically active targets for biting. The bites received by owners as the result of interfering are often severe. Hitting or kicking dogs while they are fighting may only serve to inflame animosities or result in a bite to hand or foot or possibly cause an unintentional injury to one of the dogs. Although dogs rarely kill one another, letting dogs fight until one subdues the other may result in a rapid and uncontrollable escalation of aggression, perhaps causing serious injuries and expensive veterinary treatments. The danger is increased when unevenly matched or strange dogs are let alone to fight

it out. The majority of dog fights are rather noisy and unskilled affairs that are more about getting out of the fight than winning it, making it fairly easy for an assertive person to break them up. In contrast, serious fights between experienced combatants are often much more quiet and focused on conserving energy and acquiring favorable bite holds. Dogs with a propensity to fight should be kept under appropriate muzzle or leash control at all times when they are around other dogs in order to help prevent fights and to provide safe means to separate them should a fight break out. When potentially aggressive dogs are left alone, they should either be crated or confined to separate rooms.

Some experts have suggested that shouting reprimands or yelling obedience commands like "Sit!" might stop dogfights. In practice, such vocal demands will likely go unheeded and may actually inflame the situation, especially if the fight is well under way. An assertive reprimand, startling noise, or sharp leash jerk might be sufficient to interrupt a fight before it begins, but once the fight is under way yelling loud commands typically does little good. Although an experienced trainer can often succeed in breaking up a fight by force of will and intimidation without being bitten or causing more harm, the average dog owner or handler is more likely to be bitten and should be discouraged from getting between fighting dogs or attempting to jerk them apart, a procedure that might cause more serious injuries to the dogs. Since restraining one dog while the other one is free to attack at will puts the restrained combatant at a significant disadvantage and increases its risk of sustaining injuries, whenever possible two people should work together to separate fighting dogs. Pulling the dogs steadily apart by leash without jerking them is frequently effective. When outdoors, a large bucket of water and hose should be kept ready for emergencies. When fighting breaks out, the bucket of water is splashed on the combatants, thereby often (but not always) dousing their enthusiasm for the fight. A hose delivering a forceful stream of water typically works better. Indoors, a large bath towel can be soaked in water and kept in a plastic bag for emergency use. The towel is thrown over the dogs, whereupon they can be more easily separated by leash. In addition, quart-sized plastic bottles containing club soda can be strategically placed around the house. Another method uses a modified carbon-dioxide pump to spray a disruptive blast of compressed air at the rear end or belly of the attacking dog to disrupt the fighting impulse.

As a serious fight develops, experienced fighters may take mutual bite holds where they periodically shake their heads to set deep puncture wounds or grind into the flesh of the other dog and refuse to let go. Assuming that both dogs are leashed, in some cases squirting club soda in the mouth and face of fighters can cause them to break their bite holds. In other cases a foamy shaving cream can be sprayed liberally on the nose and mouth of aggressors to help loosen bites before pulling them apart by leash. A highly effective alternative employs two or three aromatic ammonia inhalers that are taped to the handle of a leash. After the inhalers are broken, they can be tangled near the nose of fighting dogs as they are pulled apart. The number of ammonia inhalers broken is determined by need, with the majority of dogs requiring that only one ampoule be crushed. Ammonia inhalers should not be presented by hand, because a dog may rapidly break its hold only to transfer the bite to the hand holding the ammonia inhaler.

When dogs fight off leash, separating them is considerably more complicated and risky. Despite opinions to the contrary, lifting a dog by its tail or hind legs does not reliably inhibit aggression or stop fighting. Grabbing fighting dogs by their rear legs or the base of their tails can work, but these are dangerous practices with large and highly aggressive dogs that risks evoking a redirected attack. The method requires two experienced handlers possessing sufficient strength to control the dogs properly after breaking up the fight to avert being bitten on the rebound. Also, dogs handled in such a way may twist and flail about and snap to break free only to race back and attack the other dog again. A better approach involves passing a leash around the dog's waist and then hooking the bolt snap

over the leash to form a noose. The noose is cinched up snugly and steady pressure is applied, lifting up and the pulling back until they let go. An alternative method used to set a waist noose involves passing the bolt snap through the handle of the leash. If a leash is not handy, a strong belt can be used instead. The foregoing method can be modified in situations where only one handler is available. A waist noose is applied to the more aggressive of two dogs, and both dogs are dragged to a place where the restrained dog can be safely tied off. A waist noose can now be applied to the second dog while various techniques are used to break the aggressor's bite (e.g., ammonia inhaler, club soda, shaving cream, compressed air, or breaking stick in the case of some fighting breeds) while the second dog is steadily pulled away. All bite wounds received by dogs during fights should receive veterinary treatment to prevent infection.

Repulsing the Approach of Threatening Dogs

Highly aggressive dogs should be muzzled or restrained on a muzzle-clamping halter when in public places. When performing exposure procedures in public, a risk always exists that another dog wandering around without supervision will approach the handler and dog. Every effort should be made to avoid such encounters and places where such situations might develop. Allowing an established aggressor to negotiate with a strange dog of unknown aggressive propensities poses a significant risk that might be penalized by the instigation of a fight and a significant setback in the dog's training. The approach of a potentially aggressive dog requires handler intervention to maintain a safe space between the approaching dog and the dog on leash. Preparation is crucial for effective prevention and control. When approached by a threatening dog, the handler should take account of all possible alternatives to direct confrontation, but given that the encounter is likely to occur, immediate precautions and preparations for decisive action should be taken. Keeping the dogs apart is usually far easier than breaking up a fight. The first step is to reinforce control over the dog by firmly grasping the leash with the left hand and setting a brake (see *Leash Handling* in Chapter 1). The remaining portion of the leash and handle is then tossed back over the right shoulder. The right hand should grasp the standing end of the leash just in front of the shoulder in preparation to swing the leash handle down forcefully, if necessary, to strike the approaching dog with enough force to turn it away.

In the case of an approaching dog that represents a limited menace, throwing a handful of treats in its direction can give the handler and his or her dog time to escape the situation. If the procedure works, it might need to be repeated several times to keep the other dog at a distance. In the case of a more persistent dog, a threatening step or two in the dog's direction, combined with a direct stare and shout ("Go Away!"), is often enough to cut short the adventure and cause the dog to veer away or to remain at a safe distance. If the dog ignores the warning and continues to approach with a threatening attitude, the handler might need to assert more forceful measures to deter its approach. Depending on the urgency of the situation, the handler might have enough time to first cast a forceful swing of the leash across the dog's path. This strategy, while kindhearted to the intruding dog, might complicate the situation and make it more difficult to ultimately control if the dog turns out to be looking for a fight. The deterrence of the warning flick may stop the dog from moving straight in, but not keep it from circling around to the rear or rushing in at the flank. Many dogs that get within close range can be deterred by a blast of compressed air. For ordinary purposes, a walking stick provides the best general defense against the threat of unsupervised dogs. The stick is used to jab at the aggressor in order to keep it at bay, not to pummel it.

SEX HORMONES AND INTRASPECIFIC AGGRESSION

Perinatal Distress, Androgenization, and Intrauterine Position Effects

Perinatal distress in association with obstetric complications has been shown to blunt pre-

frontal DA inhibitory transmission while at the same time increasing excitatory mesolimbic DA activity (Brake et al., 2000). Diminished medial prefrontal cortex (mPFC) activity appears to reduce an animal's ability to competently regulate subcortical activity, to optimize adaptive coping efforts, and to selectively focus attention and impulse control. Trauma during this critical period of biobehavioral integration may lay the groundwork for the development of various aberrant forms of impulsive behavior in predisposed dogs. The attention and impulse-control deficits, distractibility, and hyperactivity associated with birth-related distress may offer useful clues relevant to the etiology of canine hyperkinesis and other developmental behavior problems in dogs associated with exploitative obtrusiveness and social impulsivity.

A significant gender-related influence affecting the integration and attunement of autonomic control may stem from sexually dimorphic maturation rates. Among rats, DA fibers begin reaching prefrontal destinations earlier in the gestation period than 5-HT and NE fibers and continue to develop and proliferate later than them as well (Berger-Sweeney and Hohmann, 1997). Due to the influence of gonadal hormones, DA afferent pathways targeting executive control areas in the mPFC develop more rapidly in females than in males. These gender differences in the development of prefrontal DA pathways agree with developmental findings (Wilsson and Sundgren, 1998). At week 8, male and female puppies show clear maturational differences. Females are more active, spend more time exploring and less time in close proximity with the experimenter, and are more interested in objects than are male puppies. The delayed maturation of prefrontal DA pathways and mesocortical organization may confer an added vulnerability to environmental or social insults (Brake et al., 2000), perhaps adversely affecting the male puppy's ability to regulate emotion and impulse in adulthood. The canine PFC does not appear to reach full functional capacity until the end of the first year, marked by the emergence of object-permanence abilities and mature working memory (Gagnon and Dore, 1994).

Shortly before and after birth, a surge of gonadal testosterone enters the brain of male puppies, where it undergoes enzymatic conversion into hormonal derivatives that bind to androgen and estrogen receptors expressed in various target areas of the brain. The perinatal action of sex steroids on the brain predisposes dogs to express gender-appropriate social and reproductive behavior at puberty and adulthood. Among most animals, sex steroids play an active role in the organization of social hierarchy and territory via the development of species-typical patterns of agonistic and reproductive behavior. Sex hormones mediate numerous physiological, structural, and connectivity changes to serotonergic and other neural pathways that contribute to the regulation of mood, emotional reactivity, and aggression thresholds. Adverse prenatal and perinatal conditions may disturb the organization of androgen- and estrogen-responsive pathways, perhaps predisposing susceptible dogs to show lower reactive thresholds and impulsivity toward provocative social stressors in adulthood. The higher incidence of fighting problems among male dogs may be linked to perinatal androgenizing influences affecting the serotonergic system. For example, blockade of 5-HT_{1A} receptors during week 2 postpartum increases offensive aggression in adult intact rats, but a similar antagonist treatment failed to increase offensive aggression in female rats or male rats castrated on day 1 (Albonetti et al., 1996). In spontaneously hypertensive rats, an animal model of ADHD, early testosterone treatment has been shown to integrate a persistent HPA-axis dysfunction resulting in high ACTH levels and a blunted adrenocortical response (King et al., 2000)—a state of allostatic hypodrive that may dysregulate the SAM system.

In addition to the behavioral effects of perinatal testosterone on the central nervous system of male dogs, in utero exposure to testosterone may alter reactive thresholds in adult female dogs (see *Perinatal Androgenization* in Volume 2, Chapter 7). Female fetuses may be androgenized in a number of physiological, morphological, and behavioral ways by the transfer of testosterone from males to adjacent females situated between them.

Intrauterine position effects have not been definitively demonstrated in dogs, but have been shown to exert a significant influence on aggressive behavior in a number of other species (Ryan and Vandenbergh, 2002). For example, female mice and pig fetuses situated between males initiate more fights than females situated between other females. Interestingly, males situated between other males appear to be more sensitive to the effects of testosterone at maturity. These findings may account for some of the individual differences shown by dogs in response to elevated pubertal testosterone activity and response to castration. Females situated between other females may be more adversely affected by prenatal stress, suggesting that intrauterine exposure to testosterone may have a protective effect. Exposure to excessive stress or lack of appropriate stimulation during this perinatal period may exert lasting changes in the organization of aggression-mediating circuits.

Castration and Hormonal Therapy

Since a hormonal factor is believed to play a role in the development of intermale aggression, castration is frequently recommended (see *Hormonal Influences* in Volume 2, Chapter 7). Surprisingly, the effects of castration on dog fighting have not been carefully studied or documented (see *Effects of Castration on Aggressive Behavior* in Volume 2, Chapter 6). Existent studies are confounded by methodological shortcomings and suffer from inadequate sample sizes from which to derive therapeutic conclusions. The most commonly cited study estimates that approximately 40% to 60% of intermale aggressors show a combination of short-term improvement (within 2 weeks) and long-term improvement (after 6 months) following surgery (Hopkins et al., 1976). What this improvement exactly means is not clarified. Unfortunately, the potential beneficial effects of castration are often exaggerated, causing great dissatisfaction when the procedure fails to produce the hoped-for relief. Even where significant change is evident, it is rarely dramatic and almost never complete, especially when an experienced dog fighter is involved.

Clearly, the effects of castration are variable, with some dogs experiencing little or no discernible benefit. The author's impression is that very few adult dogs give up fighting as the result of castration. A few owners have reported that their dog's fighting activity actually worsened after castration. A frequently overlooked benefit of neutering is the effect it appears to have on other dogs. The most commonly observed consequence of neutering is a decline in the frequency of challenges and attacks directed against the castrated dog by intact males. Intact dogs may find castrated or prepubertal dogs less attractive to fight or, perhaps, such dogs may simply transmit fewer provocative signals. At any rate, despite limitations and questionable efficacy, neutering should be considered in the case of serious fighting problems or in young dogs showing a heightened propensity for interdog aggression. Among rodents, castration appears to reduce 5-HT_{2A}-receptor densities in the frontal cortex and ventromedial hypothalamus (Zhang et al., 1999; Sumner and Fink, 2000). Although gonadal testosterone is entirely eliminated from a dog's bloodstream within the first 24 hours after surgery, the physiological and psychological benefits associated with neutering may take several weeks to months to develop fully. The effects of castration are sometimes augmented by the administration of progestins (see *Sex Hormones: Estrogen, Testosterone, and Progesterone* in Volume 2, Chapter 6), a problematic option that is occasionally used in cases unresponsive to castration alone (Hart and Eckstein, 1998). Male dogs treated with progestins may produce a confusing olfactory signature that short-circuits the aggressor's interests, perhaps making treated dogs less attractive as targets for attack. Also, dogs treated with progestins appear to be less interested in fighting. Progestin therapy is associated with several potential side effects that should be evaluated by the supervising veterinarian and carefully monitored.

Testosterone, Serotonin Therapy, and Intraspecific Aggression

Although the use of serotonergic medications for the control of interdog aggression is need-

ful of clinical evaluation and controlled trials, some preclinical evidence suggests that circulating testosterone might provide a permissive or facilitatory effect on serotonin therapy. For example, the aggression inhibiting effects of 5-HT_{1A}- and 5-HT_{1B}-receptor agonists appear to depend on the permissive influence of androgens (Cologer-Clifford et al., 1999), suggesting the possibility that the therapeutic benefits of serotonergic agents for the treatment of dog fighting may be facilitated by the presence of circulating testosterone. Support for this hypothesis is provided by a study in vervet monkeys that evaluated the behavioral effects of three medications known to increase 5-HT activity by different mechanisms (Raleigh et al., 1985). Fluoxetine, quipazine (a 5-$HT_{1/2}$-receptor agonist), and tryptophan were given to dominant and subordinate monkeys. The researchers found that dominant individuals respond to 5-HT-enhancing therapies in a more robust manner than did subordinates. An increase in several prosocial behaviors attributed to the effects of enhanced 5-HT activity was also correlated with social dominance, including increased social approach, grooming, resting, eating, and huddling. Increased huddling was found to be a behavior produced only by fluoxetine. Dominant individuals also showed a greater reduction in negative behaviors, such as social avoidance, vigilance, and solitariness. The various 5-HT treatment regimens promoted a general calming effect and increased sociability—an effect that was especially prominent in dominant monkeys. Dominant individuals often exhibit higher levels of circulating testosterone, as well as other status-linked hormonal differences associated with HPA-system tone and gender-related agonistic behavior. For example, AVP appears to play a major role in forming hierarchical relations and territory (Ferris et al., 1986) and mobilizing power-dominance motivations (Sewards and Sewards, 2003). AVP-mediated aggressive behavior among hamsters is testosterone dependent (Delville et al., 1996). Ferris and colleagues (1997) found that fluoxetine inhibits gender-related offensive aggression in hamsters by antagonizing the action of AVP in the hypothalamus via 5-HT_{1A} receptors. These reports emphasize the close interaction among AVP, testosterone, and 5-HT in the regulation of agonistic behavior. Most dogs showing serious intraspecific aggression problems are routinely castrated prior to drug-therapy initiation. Given the aforementioned findings, the absence of circulating testosterone might reduce the efficacy of selective serotonin (5-HT) reuptake inhibitor (SSRI) medications such as fluoxetine for controlling gender-related intraspecific aggression. The foregoing data also suggest that aggressive dogs left intact during fluoxetine therapy might respond better to treatment. For previously castrated dogs, combination treatments incorporating dehydroepiandrosterone (DHEA), the adrenocortical precursor to testosterone and estrogen, with a compatible SSRI might prove useful (Wolkowitz et al., 1999).

Aggression Toward Cats in the Household

A common aggression problem involves dogs that chase or attack cats living in the same household. Once established, the urge to stalk and chase or attack cats can be highly resistant to behavioral change. Dogs that show a propensity to attack and injure or kill cats represent a significant risk, and they (or the cats) should be removed from the home. In other cases, dogs that lack appropriate training and socialization with cats may engage in playful chase escapades that cause the target cat significant distress. Often cats exposed to an aggressive or playful dog may remain in a part of the house that is inaccessible to the dog and only occasionally come out of hiding. Dogs prone to chase cats should be exposed to remedial socialization, reward-based integrated compliance training, and appropriate inhibitory all-stop conditioning aimed at suppressing the chase impulse. Most cases involving such behavior can be managed successfully by using a combined approach of exposure-habituation, response prevention, and graduated counterconditioning.

Getting the dog accustomed to being around the cat without evoking a chase response is best achieved by habituating the

cat to a wire carrier. Attempting to restrain a cat by leashing it with a harness or collar is highly problematic and can result in serious scratch and bite injuries to the handler. Carrier confinement allows the dog to approach the cat safely while minimizing undesirable behavior. The cat and dog are exposed to graduated counterconditioning under diverse circumstances. The leashed dog is progressively moved toward the confined cat while being fed a highly valued food item. One technique involves coating a wooden spoon with peanut butter and allowing the dog to lick from it as it approaches the cat in stages without becoming reactive. The cat should also be fed a highly prized treat (e.g., puréed tuna) through the carrier by a helper. A muzzle-clamping halter or muzzle can be used to help discourage lunging and barking. Incorporating brief exclusionary TO with DRO training can also reduce such behavior. In cases not sufficiently responsive to the foregoing training efforts, remote electronic training can be used to entrain potent inhibitory control over chasing behavior. Internal electronic containment can be used to reinforce such training, but such devices are far from foolproof, and under the excitement of the chase the dog may run through the field and attack the cat. Dogs with a history of chasing cats should either be crated or be confined to a safe room when left alone. A device that could be helpful for controlling undesirable canine behavior around cats would involve a small medallion worn by the cat. If the cat is approached within a certain critical distance, a receiver device worn by the dog is activated that delivers an appropriate warning and aversive stimulus of sufficient strength to cause the dog to avoid the cat.

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9

Biobehavioral Monitoring and Electronic Control of Behavior

PART 1: MONITORING AUTONOMIC AND EMOTIONAL STATES

STRESS, TEMPERATURE, AND BEHAVIOR

In addition to preparing dogs for physical exertion and emergency action, the sympathetic nervous system mediates physiological changes associated with thermoregulatory control that closely parallel the preparatory arousal associated with fear and anger. Thermoregulatory adaptations for coping with thermogenic changes appear to have been recruited and incorporated into systems evolved to cope with emotional stressors (e.g., decreased/increased activity, vascular dilation/constriction, panting, sweating, shivering, and piloerection). The close relationship between physiological changes associated with thermoregulation and sympathetic arousal suggests an interesting potential relationship between reactive emotional states and increased thermogenesis. The persistent panting and excessive salivation exhibited by some separation-reactive and separation-distressed hyperactive dogs may reflect a shift in energy metabolism and thermogenesis resulting from reactive states triggered by the loss of social contact or control over significant events. The reactive relationship between separation distress and increased thermoregulatory activity suggests an interesting developmental hypothesis; namely, the contact dynamics between neonatal puppies while mediating mutual thermoregulation may orchestrate the expression of neurobiological substrates that anticipate the later emergence of social attraction and attachment behavior, and the integration of competent regulation of sympathovagal arousal and impulse control. According to this hypothesis, early stressors and insults affecting canine thermoregulatory capacity may exert far-reaching effects on the organization of sympathetic regulatory networks needed to competently modulate reactive thresholds controlling separation distress and flight-fight behavior. These reactive propensities may be partially revealed by the size of differences between basal body temperatures and temperatures obtained after exposing the dog to provocative stimulation. In addition to early developmental insults, thermogenesis and compensatory thermoregulatory changes appear to be strongly influenced by individual genetic differences. Corson and colleagues (1973), for example, found that dogs differentiate along two general lines in the way they cope with exposure to uncontrollable aversive stimulation. The first group, referred to as *anti-diuretic* types, shows a quintet of reactive physiological changes: tachycardia, persistent hyperpnea, excessive salivation, and increased secretion of vasopressin. The researchers hypothesized that these sympathetic changes were a reactive pattern of compensatory thermoregulation in response to a reactive increase in energy metabolism and thermogenesis. Other dogs, referred to as *diuretic* types, responded to the same uncontrollable stimulation in a less global and reactive way, showing a greater capacity to adapt, consistent with a well-developed flirt-and-forbear anti-stress system. These findings suggest the possibility that temperament differences affecting a dog's relative ability to cope with provocative stimuli may be revealed and indexed by the size of temperature changes evoked by uncontrollable threats and challenges.

Although the significance of core temperature to temperament in dogs remains to be worked out in detail, body temperature appears to provide a sensitive index of psychological distress and stress in laboratory rodents. Stress-induced hyperthermia is associated with anticipatory anxiety and increased glucocorticoid activity (Groenink et al., 1994). Exposure to social conflict can produce durable changes in daily temperature patterns, depending on whether the animal accepts defeat or fights back (see Meerlo et al., 1996 and 1999). Other research has shown that temperature changes are particularly sensitive to psychological stressors as opposed to physical ones. Long-term temperature changes can occur in association with the psychological distress from being in the same compartment with conspecifics receiving daily sessions of shock delivered every 60 seconds for an hour over 12 weeks. Distressed bystander rats showed a long-term elevation in temperature, with a 0.20°C elevation in

temperature after a 2- to 3-month rest period (Endo and Shiraki, 2000). Among rats, temperature change appears to index contextual fear conditioning, perhaps warranting validation in dogs (see Godsil et al., 2000). These findings suggest that tracking temperature changes might be a useful noninvasive tool for assessing psychological distress in dogs.

Functional Lateralization and Tympanic Temperature

Some lines of research have formed around the significance of tympanic temperature differences between the ears as measured by infrared tympanic thermometers. These temperature differences may be due to lateralized cortical functions, with right-side prefrontal asymmetries associated with the behavioral inhibition system (BIS), negative emotion, inhibition, hesitation, stress regulation, defensive behavior, anxious arousal, and passive modal strategies, whereas left-side prefrontal asymmetries appear to be associated with the behavioral approach system (BAS), positive emotion and arousal, curiosity, surprise, joy, exploration, offensive behavior and trait anger (Harmon-Jones and Sigelman, 2001), and active modal strategies. Anger generating positive affect, arousal, confidence, struggle, conquest, and power appears to be integrated by the BAS (see Harmon-Jones, 2003), whereas the BIS integrates negative affect, anxiety, disappointment, resentment, defeat, and failure. According to this hypothesis, both the BAS and the BIS play a role in representing different functional and motivational aspects of anger and anxiety.

In conjunction with executive functions, the prefrontal cortex (PFC) appears to index and modulate allostatic load via hypothalamic-pituitary-adrenal (HPA)-system regulation (Diorio et al., 1993)—a function performed chiefly by the right medial PFC (Sullivan and Gratton, 1999). The frontal area via the anterior cingulate cortex (ACC) also figures prominently in the integration of attention shifting, emotional processing, and the corticovisceral regulation of sympathovagal tone (Thayer and Lane, 2000). Consistent with the lateralization of cognitive functions, the orienting response of a dog to a click or the presentation of food following a conditioned stimulus evokes increased electroencephalogram (EEG) activity in the left cerebral hemisphere, whereas once the orienting response to the click is extinguished, the click stimulus tends to increase activity in the right hemisphere (Simonov et al., 1995). While processing novel auditory and visual stimuli, left lateralization appears to predominate, but, as the conditioned response is well established, asymmetry is either absent or shifts to the right hemisphere (Preobrazhenskaia, 2000).

In general, right hemisphere specializations are organized to cope with defensive demands and threats evoking withdrawal and behavioral inhibition, whereas left lateral hemisphere adaptations are closely tied to approach, behavioral activation, challenging situations, and heightened appetitive drive states. The right hemisphere appears to promote withdrawal, anxious arousal, and activation of the HPA system (Wittling and Pfluger, 1990). When the provocative event is uncontrollable, cortisol levels may dramatically increase along with a heighten risk for defensive or reactive aggression in predisposed dogs. In contrast, increased left frontal activity tends to be associated with positively valenced states of arousal promoting approach, power, and potential for offensive or impulsive aggression. In contrast to the increased cortisol levels observed in association with right hemisphere stimulation, left hemisphere activation in response to emotionally aversive stimuli tends to suppress salivary cortisol secretion (Wittling and Pfluger, 1990), a finding consistent with a hypothesized linkage between low cortisol levels and impulsive aggression.

Lateral shifting of cortical activity appears to anticipate changes in brain metabolism rates and vascular flow to the left and right sides of the brain, depending on the processing being performed. These metabolic and vascular changes appear to be reflected in rapid changes in temperature. Among chimpanzees, for example, observing a video recording of severe aggression results in elevated right-ear tympanic temperature,

whereas observing neutral images or images of playful activity does not alter baseline temperatures (Parr and Hopkins, 2000). When engaged in visual cognitive tasks, chimpanzees show an opposite pattern of neurothermal lateralization, with left-ear temperatures increasing and right-ear temperatures decreasing (Hopkins and Fowler, 1998). Several studies have shown that human impulsive aggressors exhibit increased subcortical arousal, together with reduced right and left prefrontal activity (see Raine et al., 1997 and 1998), suggesting that impulsive aggression may be associated with reduced executive function and regulatory control over subcortical emotional states and aggressive impulses. Children with intractable partial epilepsy presenting comorbidly with impulsive aggression show temporal and bilateral medial PFC (mPFC) hypometabolism (Juhasz et al., 2001). Maximal differences in cerebral glucose metabolism were found in the right and left middle temporal gyrus in comparison to nonaggressive children with epilepsy. The foregoing is consistent with the notion that the right hemisphere might play a predominant role in the representation and modulation of excitatory sympathetic arousal mediating rapid behavioral adjustments to emotionally provocative threats and uncertainty (Wittling, 1990; Wittling et al., 1998b), whereas the left hemisphere is more directly involved in the modulation of parasympathetic pathways in association with emotional arousal mediating social coping and control strategies (Wittling et al, 1998a). In combination, left and right hemispheres exercise profound autonomic attunement and integrative influences over blood pressure, heart rate, and HPA-system activity.

Paw Preference, Laterality, and Tympanic Thermal Asymmetry

Tan (1987) has reported that more dogs exhibit a right-paw preference (57.1%) than a left-paw preference (17.9%), with 25% being ambidextrous (N = 28, 19 females and 9 males). Wells (2003) has shown that the lateralized preference for paw use is probably gender related in dogs, with females appearing to show a right-paw preference and male dogs tending to show a left-paw preference. However, Wells' findings concerning paw preference are possibly confounded by an uncontrolled influence of previous training, at least with respect to one of the tasks used to evaluate handedness (i.e., giving a paw). More recently, though, Quaranta and colleagues (2004) have reported additional data concerning the lateralization of paw preference that appears to support Wells' gender hypothesis. They also report evidence suggesting that paw-use lateralization is correlated with various immune functions; however, these immune differences are not correlated with gender. Since dogs show evidence of cerebral asymmetry, with the right hemisphere tending to be significantly heavier and larger than the left in most dogs (Tan and Caliskan, 1987a and b), one might suppose that paw preference is related to morphological asymmetry, but Tan could not establish a correlation between brain morphology and a specific paw preference in dogs. The larger mass and area comprising the right hemisphere suggests that the right side of the brain should be associated with increased metabolic activity and blood flow in association with right cerebral dominance. Research on paw preference in rodents introduces an interesting dimension to this hypothesis. As in dogs, the right hemisphere of rats tends to be larger than the left. In addition, rats exhibit a pattern of neurothermal asymmetry that is correlated with paw-use preference (Klimenko, 2000), but the temperature gradient between left and right hemispheres is most conspicuous in left-handed rats and least so in right-handed rats; ambidextrous rats show an intermediate thermal gradient. These various differences affecting interhemisphere thermal gradients appear to be ontogenetically stable (Klimenko, 2001). Temperature kinetics on the surface of the cerebrum that have been imaged in rats (Shevelev et al., 1986) indicate relatively rapid left-right and right-left hemispheric asymmetries and crossover patterns of movement and equilibrium. The stability of interhemisphere thermal gradients from an early age raises the possibility that tympanic temperature might be of value in identifying temperament traits

and coping styles early in life. Further, given the findings reported by Quaranta and colleagues in dogs and numerous studies in rodents linking behavioral lateralization and neural asymmetries to immune reactivity (Fu et al., 2003) and HPA-system activation (Neveu and Moya, 1997), both aspects of adaptation may be correlated with tympanic thermal asymmetries and changes in bodily temperature associated with stress and sickness. Rodents showing a right-paw preference appear to be more vulnerable to physical and behavioral stressors (Neveu et al., 1998), whereas those exhibiting a left-paw preference may be more prone to immune disorders (Fu et al., 2003). Consequently, it would be of interest to learn whether the basal intertympanic thermal gradient is a good predictor of paw-use preferences in dogs.

Measuring Tympanic Temperature

Thermal scanners can be used to rapidly (in 1 second) and accurately measure tympanic temperatures from a dog's ear. Whenever possible, at least three readings from each ear should be taken and a mean score assigned. Tympanic thermal asymmetries may possess value as novel endophenotypes identifying temperament traits and coping styles, as appears to be the case among children (Boyce et al., 2002) and various animal species. Tomaz and colleagues (2003), for example, have reported that marmosets exhibit asymmetrical tympanic temperature shifts consistent with a right brain specialization for coping with capture/restraint stress and fear. Monkeys that have been repeatedly captured show a significant reduction in tympanic temperatures on the right side. A similar effect appears to occur in some dogs. For example, temperature readings from a nonaggressive but emotionally reactive Labrador retriever (5-year-old neutered male), which responded with vigorous escape arousal associated with restraint, initially showed a left-right asymmetry (left ear, 102.1°F; and right ear, 100.6°F). However, after the struggling ceased, a slightly opposite right-left asymmetry (left ear, 101.5°F; and right ear, 102.0°F) emerged that was followed by a gradual temperature decrease and left-right equilibrium in association with comforting talk and massage (left ear, 100.6°F; and right ear, 100.3°F).

Some preliminary data suggest that dogs exhibiting canine impulsive aggression may show lateralized tympanic temperature variations consistent with the foregoing hypothesis. For example, a male Wheaton terrier (neutered 3-year-old) with a history of threatening and biting strangers and familiar visitors showed an initial increase in temperature in the left ear in association with the ringing of a doorbell plus greeting (left ear, 99.1°F; and right ear, 98.0°F). A follow-up reading taken after the trainer had been in the house for approximately 1 hour showed that the temperature range had not significantly changed but that the asymmetry had shifted from the left to the right ear (left ear, 98.7°F; and right ear, 99.4°F). The initial higher left-ear temperature may reflect an increase in glucose metabolism or a change in regional blood flow to the left side of the brain in response to the sudden change and the excitement triggered by the unexpected visit. The relatively low temperatures in response to the doorbell is a bit surprising, however, since the dog was highly agitated and aggressive (e.g., strong threat barking, lunging, and vigilant readiness)—behavior that one might expect to elevate temperature. The presence of a low basal cortical temperature is consistent with increased regional blood flow. Cerebral blood flow in dogs appears to be autoregulated by means of metabolic signals, consistent with the idea that the lower temperature may reflect a rapid increase in arterial flow of blood to the left or right side of the brain.

In another case, a female Saint Bernard (spayed 1-year-old) that showed hyperactivity and extreme delay-of-gratification deficits, intrafamilial agonism, and social control/frustration intolerance from an early age onward toward one particular male family member exhibited an unusual pattern of tympanic asymmetries and temperature fluctuations consistent with decreased cerebral metabolic activity or pronounced cerebral blood-flow changes. In contrast to the pattern of impulsivity exhibited by the aforementioned Wheaton, the Saint Bernard exhibited a pat-

tern of intrusive hyperexcitability and exploitive behavior toward visitors. Tympanic temperatures taken 15 to 20 minutes after arriving at the home indicated a right-left asymmetry (left ear, 100.4°F; and right ear, 102.0°F). After a long walk, tympanic temperatures were taken again. Interestingly, as the family member who was the prime target of aggression approached to help restrain the dog during the scanning procedure, the dog's temperature plunged bilaterally (left ear, 95.2°F; and right ear, 95.3°F). Since these measurements seemed oddly low, a second measurement was taken that confirmed a significant hypothermic event (left ear, 96.6°F; and right ear, 97.1°F). The dog's tympanic temperatures continued to move in the direction of normothermia and an opposite left-right asymmetry as it calmed (left ear, 101.4°F; and right ear, 100.3°F).

CARDIOVASCULAR ACTIVITY AND EMOTIONAL BEHAVIOR

Early factor analyses found that various cardiovascular patterns loaded with certain emotional variables and temperament traits in dogs (Royce, 1955; Brace, 1962; Scott and Fuller, 1965; Cattell and Korth, 1973). Royce's work, in particular, points intriguingly toward a potential link between temperament, heart rate, vagal tone, and emotional tendencies predisposing a dog toward reactive behavior. For example, he found that heart-rate changes in response to divergent social stimuli, including potent vagal braking effects in response to both calming and threatening vocal control efforts, loaded with an increased tendency toward behavioral reactivity. Royce describes an aggression factor that occurs with impulsiveness and a deceleration in heart rate in response to electric shock. Vagal braking in response to both shock and a threatening voice is also associated with an unidentified trait consisting of attraction, dominance, and temperature variables. Royce also found that dogs showing an increased propensity for behavioral reactivity exhibit a rapid sympathetic acceleration in heart rate in response to muzzling restraint, but showed no change in heart rate when administered an electric shock.

Heart Rate

Among laboratory dogs, Beerda and colleagues (1998) reported a nonspecific increase in heart rate in response to both social and nonsocial stressors, concluding that "heart rate increases should best be regarded as general responses to possibly meaningful events, irrespective of whether these are appreciated as positive or negative" (378). Although these researchers could not demonstrate the existence of discriminative heart-rate changes in response to acute social and nonsocial stressors, they did show differences in the HPA activity of dogs exposed to nonsocial stressors (e.g., loud sound, electric shocks, and a falling bag) versus dogs exposed to social restraint and startle delivered by a social object. Whereas nonsocial fear-eliciting stimuli increased cortisol release, startling events (repeatedly opening an umbrella in the dog's direction) and mechanically forcing the dog down to the floor by pulling up on a rope passed under a bar fixed to the floor or by shoving it down by hand and holding it there for 20 seconds (restraint) did not increase cortisol release. The steady pulling and manhandling procedure was performed twice with a 20-second interval between each trial. All of the social procedures were performed with the experimenter wearing a mask, hat, and coat scented with an unfamiliar odor. Despite the directive challenge, risk, and novelty of such stimulation, no significant increase in cortisol activity was observed. The absence of stress in response to restraint (defeat) is opposite to the robust and long-lasting effects that novelty and social defeat have on other species tested under laboratory conditions (see Koolhaas et al., 1997). The increased submissive precursor behaviors exhibited by challenged dogs (e.g., oral activities, paw lifting, slightly lower body posture, changes in ear position, and other signs of submission) appear to reflect a standing readiness to submit mediated by an effect of person. This hypothesis is consistent with a specialized flirt-and-forbear antistress system and enhanced parasympathetic capacities that enable dogs to cope with challenges and risks in a nonstressful manner, whereby the HPA system remains relatively unperturbed even though a dog shows various submissive pre-

cursors. In the absence of the flirt-and-forbear antistress system (e.g., socialized wolves), similar social challenges and threats would likely cause stressful flight-or-fight reactions and the activation of HPA system.

Recently, King and colleagues (2003) have suggested that heart rate might be a more practical and sensitive measure of a dog's reactivity to novelty and fear than are cortisol levels. Other researchers have found that a reactive pattern of cardiac acceleration and deceleration in response to social and environmental stressors appears to correlate with an increased vulnerability to reactive social behavior and stress proneness (Vincent and Michell, 1996; Vincent and Leahy, 1997) (see *Autonomic Arousal, Heart Rate, and Aggression* in Chapter 6). Blood-pressure and heart-rate changes appear to be highly sensitive to traumatic events, and conditioned cardiovascular changes may persist (schizokinesis) or worsen (autokinesis) long after the overt escape/avoidance behavior has ceased (Dykman and Gantt, 1997).

The evolution of specialized flirt-and-forbear antistress capacities has given dogs relatively sophisticated capacities for maintaining sympathovagal balance and HPA-system stability via the integration of an adaptive coping style in the context of forming secure attachments. The integrated and refined attention and impulse control resulting from adaptive learning and the vagal-mediated attunement of autonomic control systems reguates increases or decreases of heart rate in anticipation of expected needs, motivational changes that enable dogs to cope with social challenges and risks without becoming overly stressed by them. The failure of earlier work (Beerda et al., 1998) to detect a differentiation of heart rate in response to different stressors might be understood within the context of these adaptive specializations evolved by dogs to cope with domestic life. Accordingly, companion or service dogs (see Vincent and Leahy, 1997) reared under the influence of consistent and enriched home or training environments may express autonomic elaborations and complex attunement dynamics while integrating an adaptive coping style that dogs living under the more austere and impoverished conditions of the laboratory do not acquire. In addition, rewarding exchanges that occur within the home setting appear to be necessary precursors for the activation of the social engagement system (SES), which, in turn, facilitates vagal-mediated secure social and place attachments.

Heart-rate Variability

Cardiac markers of sympathetic or parasympathetic tone may be useful for detecting disturbances affecting the SES. For example, sympathetically reactive wild rats exhibit dramatically more arrhythmic ventricular events (premature beats) and less parasympathetic rebound after defeat than do Wistar rats, a strain that is more sociable and less reactive to novel social stimuli and showing increased heart-rate variability and marked vagal recruitment following defeat stress (Sgoifa et al., 1998). In another study, Sgoifa and colleagues (1999) found that wild rats also exhibit significant differences in the way they respond to social versus nonsocial stressors, with wild rats showing more ventricular arrhythmias and sympathetic dominance after social stress than after nonsocial stress (restraint).

Dogs appear to produce a comparatively greater parasympathetic inhibition over cardiovascular activity than do humans (Little et al., 1999). When orienting toward novel stimuli, dogs show a rapid decrease in heart rate that continues while engaged in sustained attention or exploratory activities. A lower heart rate is also produced by a wide range of evoking social stimuli, including petting, muzzle holding, pinning, and holding in the arms, suggesting that parasympathetic motor systems may play an integral role in the integration of submission behaviors (Fox, 1978) and hierarchic relations (Sgoifa et al., 2001). Scott and Fuller (1965) observed that respiratory sinus arrhythmia (RSA) and heart rate are closely related among dogs, in that a slow heart rate is typically arrhythmic, whereas a fast heart rate is usually more regular and indicative of increased sympathetic tone. While lying down and resting, heart activity is prominently under the control of parasympa-

thetic tone, whereas, when standing, heart rate is a composite of sympathetic and parasympathetic components (Palazzolo et al., 1998). During emotionally exciting events, parasympathetic control is withdrawn, causing the heart rate to increase, whereas the reinstatement of parasympathetic control (vagal braking) by vocal reassurance or petting decreases heart rate while increasing heart-rate rhythm variability. As a result, measures of *heart-rate variability* (HRV)—that is, beat-to-beat changes in heart rate—appears to reflect the state of autonomic systems mediating behavioral adjustments and may be useful for evaluating the effects of stress on sympathovagal tone and reactive/impulsive adjustment (Pagani et al., 1986; Billman and Dujardin, 1990).

Hypothetically, dogs expressing relatively high tonic HRV measures might be expected to be more adaptable and to habituate more rapidly to social and environmental novelty and unexpected change, whereas dogs expressing reduced tonic HRV should tend to be more reactive and exhibit a nonhabituating orientation toward novelty and unexpected change. The normally reduced heart rate in response to environmental and social exploration may be diminished or unstable in such dogs, especially when exposed to unfamiliar situations or novel social targets. In addition, dogs exhibiting reactive arousal show variable amounts of plasma adrenal epinephrine and norepinephrine, depending on the relative contributions of anger and fear comprising the reactive state (Verrier and Dickerson, 1991), with epinephrine (fear) and norepinephrine (anger) representing potentially useful markers for assessing arousal and aggression risk. Dogs affected by anticipatory social anxiety may exhibit signs of persistent (nonhabituating) anxious or conflictive arousal in association with hypervigilance and readiness for defensive autoprotective behavior, changes that are correlated with heart rate, HRV, and other indicators of autonomic activation. Autonomic states associated with past anger or predisposing a dog to anger may be correlated with signature changes expressed in cardiovascular activity (see Kovach et al., 2001). As a result, cardiovascular data may provide valuable information relevant to a better understanding of the etiology and treatment of behavior problems associated with impulsivity and a reactive coping style.

As a result of social ambivalence, dispersive tensions, and chronic inhibitory strain, dogs may show signs of autonomic dysregulation in response to ambiguous or uncontrollable social stimuli or physical challenges. The relative stability of sympathovagal tone may be reflected in changes to heart rate and indexed by HRV following sensory and physical challenges (e.g., novelty, unexpected change, demands requiring sustained attention, exposure to provocative stimuli, unwelcome approach while in safe refuges, and pulling the dog by leash from a resting area). Conflict and emotional distress may contribute to the disruption of attention functions gradually impairing a dog's ability to competently engage and disengage selective attention. Social and attentional disengagement facilitate the loss of autonomic attunement, thereby significantly reducing the dog's ability to adjust arousal and to cope adaptively with changing environmental and social demands. Basic training appears to exert a beneficial influence on sympathovagal balance by improving vagal regulation over sympathetic shifts in response to novelty, handling, and restraint. Heart-rate deceleration is reliably evoked by petting dogs that respond to social tactile stimulation as a reward (Fonberg et al., 1981), perhaps contributing to the evident cognitive and emotional attunement that is brought about by the training and socialization process. Conditioned appetitive stimuli and behaviors trained in association with food reinforcement tend to promote parasympathetic balance and calming effects, as well.

The potent parasympathetic effects of stimuli anticipating the presentation of food on arousal was a central finding of Pavlov's work, with salivation being closely regulated by the parasympathetic branch of the autonomic nervous system. Among young horses, those having received training tend to be less emotionally reactive, showing a lower nonmotor heart rate and greater HRV than untrained horses (Visser et al., 2002). The adaptogenic benefits of basic training appear

to depend more on an ability to freely choose and act upon events that are relatively predictable and controllable rather than the motivational direction of the incentives prompting behavioral change (see Stichnoth, 2002). When a dog is physically immobilized, aversive events may be perceived as more threatening and conducive to the activation of autoprotective adjustments, whereas a dog that can move about freely may feel more in control, perhaps perceiving the event as being at least escapable, if not fully predictable or controllable.

Effects of Restraint and Immobilization

Many studies with diverse taxa have shown that inescapable physical restraint or the induction of cataleptiform immobility results in bradycardia, even cardiac arrest and sudden death in some cases. Richter (1957) found that wild rats held until they stopped struggling rapidly succumbed when placed into a vat of water, unlike nonstressed wild rats that continued swimming for 2 days or more. With a highly unstable dog, the mere presence of a person may trigger intense vagal braking and severe bradycardia. For example, Gantt and colleagues (1966) described a dog restrained in a Pavlovian harness whose heart rate moved from 140 to 180 bpm to as low as 20 bpm when exposed to a person standing nearby, and on several occasions this dog went into cardiac arrest for 6 to 8 seconds when petted.

A study by Reese and colleagues (1982) on the effects of physical restraint and petting on nervous and normal pointer dogs revealed intriguing behavioral and heart-rate differences in the way dogs cope with physical restraint. The dogs were restrained by turning them on their backs in a sling-restraint device. Once in the restraint sling, the dogs were calmed with stoking on the belly (1 stroke/second for a minute). After the induction phase, the dogs were left alone in the sling-restraining device during a 2-minute observation phase and watched from a separate room through a one-way mirror. Nervous pointers showed persistent cataleptiform immobility with bradycardia throughout the induction and observation phase and remained in the sling until they were tipped out of it. During a 5-minute postrestraint observation period, the nervous dogs showed a significant postrestraint sympathetic increase in heart-rate activity. In contrast, normal pointers show an initial tachycardia associated the induction phase, followed by postural and muscular relaxation, and a sustained postrestraint bradycardia as they move about after freeing themselves from the sling or upon being tipped out of the device. The normal dogs that remained in the sling after the induction period appeared relaxed and showed no head or neck immobility, and one of them even wagged its tail at the end of the 2-minute observation period. All of the nervous dogs had to be tipped out of the sling, whereupon they reflexively righted themselves and remained in an upright frozen posture during the 5-minute postrestraint period. Normal dogs that freed themselves from the sling during the 2-minute observation period exhibited more pronounced bradycardia scores (105 to 87 bpm) in comparison to normal dogs that remained in the sling (106 to 99 bpm) during the same period. The lower heart rates of the normal pointers that freed themselves may reflect parasympathetic relief associated with successful escape to freedom, whereas the sustained tachycardia of the nervous pointers may reflect increased anxious arousal associated with an escape from danger (see *Escape to Safety versus Escape from Danger* in Chapter 8).

Williams and colleagues (2003) have studied the effects of inescapable immobilization on the heart rate and HRV of a Great Dane. The dog was immobilized inside a wooden box that allowed it to stand with its head protruding from an opening in the front. Immobilization was achieved by filling the box with triple-cleaned oats until the dog's body was fully covered, allowing only its head to move about freely. To control head and neck movements, a short leash was attached to a flat collar and fastened to the front of the box. The dog was also fitted with a muzzle-clamping halter to control its head and jaws. Heart-rate and HRV data were collected by means of an ambulatory monitoring device. During a

pretest-baseline procedure, the dog was exposed to an unknown target dog to instigate aggressive arousal and establish baseline reactivity. The leashed dog showed strong reactive behavior (e.g., lunging, jumping, growling, and barking) and an elevated heart rate (160 bpm) toward the unknown dog in comparison to its response to a familiar dog (135 bpm) and no dog (111 bpm). Pretest HRVs in response to both the unknown and known dog were identical. After an hour of immobilization, the dog showed a significant decrease in heart rate (91 bpm) and an increase in HRV indicative of parasympathetic activation. During an exposure procedure in which the unknown dog was presented to the immobilized dog, first at 15 meters away and then gradually moved incrementally closer over 31 minutes, aggressive behavior was suppressed. During the postimmobilization tests, the dog "was not as reactive" toward the unknown dog and showed a decrease in heart rate together with a slight increase in HRV in comparison to preimmobilization scores. The reduced heart rate and slight increase in HRV at the end of the experiment toward the approach of an unknown dog might reflect parasympathetic relief associated with getting out of the box—a state of arousal incompatible with aggression.

Since bradycardia and alterations in HRV in dogs can be produced by a variety of procedures (e.g., petting and massage, pinning restraint, and tonic immobilization) producing a high or low level of physiological stress, future investigations should include other relevant autonomic arousal markers (e.g. catecholamine and cortisol levels) to help determine whether the immobilization procedure works by relaxing dogs or as the result of some other mechanism triggered by immobilization, fear, or loss of control (see *Stress-related Potentiation of the Flight-Fight System* in Chapter 6). In particular, many features of the procedure seem consistent with the learned-helplessness paradigm. Exposure to inescapable aversive stimulation while fully immobilized is a central feature of the learned-helplessness protocol (see *Stress, Traumatic Avoidance, and Laboratory Experiments with Shock*). Exposing a reactive dog to the slow approach of an unfamiliar dog (a social stimulus eliciting intense defensive arousal) in the manner described reminds one of being buried up to the neck in sand and then forced to watch the tide slowly come in without any means of defending oneself or escaping the encroaching threat. The induction of learned helplessness has been shown to reduce escape and avoidance behaviors and to exert potent antiaggression effects in dogs (Seligman, 1975) and rats (Maier et al., 1972), perhaps explaining the effect that the immobilization procedure is believed to have on defensive aggression in dogs (Williams and Borchelt, 2002).

The authors speculate that immobilizing restraint combined with "tactile pressure" might explain the observed changes in heart rate, HRV, and reduced aggression exhibited by the immobilized dog. They compare the immobilization procedure that they use with Grandin's squeeze machine (see *Taction and Posture-facilitated Relaxation* in Chapter 6) but overlook an essential difference: the person in the squeeze machine is not exposed to a threat slowly moving in their direction from which they cannot escape. While immobilization and "loss of control" procedures may temporarily reduce aggression, they may also adversely impact more desirable social behaviors and learning capacities that depend on voluntary initiative. Finally, in the case of highly reactive and unstable dogs or dogs with heart disorders, the stressful induction of pronounced fluctuations in heart rate by means of rapid exposure to an inescapable threat educing high levels of fear or anger under immobilizing restraint may pose a significant cardiovascular risk (Kovach et al., 2001; see Kamarck and Jennings, 1991).

Devices Used to Monitor Autonomic and Stress-related Changes

Although HRV may ultimately provide the most useful diagnostic information with respect to linking behavior problems with autonomic tone and sympathovagal imbalance, such equipment is relatively expensive and complicated to use. The dog's heart rate

is an extremely sensitive indicator of autonomic tone, often shifting dramatically in response to sympathetic arousal and showing varying degrees of receptiveness to countervailing parasympathetic influences indicative of autonomic balance. Suggestive autonomic information providing a rough index of sympathovagal tone may be derived by tracking cardiac recovery patterns in response to startling or provocative events and the modulation afforded by the delivery of arousing and calming stimuli. In addition to monitoring the dog's autonomic changes in response to petting and other rewards, various changes associated with orienting and attending, leash prompts and saccades, training modules and routines (e.g., sit-stay and down-stay training), and relaxation effects mediated by PFR can be monitored and tracked over time.

The author has found that a variety of inexpensive and readily available heart monitors can be useful for tracking autonomic shifts during training and the behavior-therapy process (see Vincent and Leahy, 1997; Stichnoth, 2002; King et al., 2003). Sports monitors provide a useful real-time window for observing and quantifying a dog's response to various training and counterconditioning procedures. These relatively inexpensive radiotelemetry devices can be attached to a harness to prevent the elastic band from shifting off the heartbeat signal. The effective use of such devices through dog hair requires that an electrode gel be applied on the skin to establish a viable signal. The monitor is attached to the top of the harness, making easy viewing possible. In addition to sports heart monitors that are fitted around the chest of a dog for recording real-time heart-rate changes, wrist-type heart-rate and blood-pressure monitors are available. Reasonably priced cuff-type monitors together with recording and graphing capability are also available and useful, especially for tracking changes in the relaxation response during PFR training. Various tympanic thermometers are readily available for measuring changes in temperature, including one device designed for dogs. Pill-sized telemetry devices are also available for tracking temperature. These pill thermometers are designed to be ingested and to transmit core temperature data. Pill thermometers offer a nonintrusive way to monitor and record real-time temperature changes (O'Brien et al., 1998), perhaps having unique applications for following stress-related changes associated with canine behavior problems. Real-time temperature information might be particularly revealing, perhaps providing a biological marker useful for the diagnosis as well as tracking the outcome of treatment efforts. Given the apparent close relationship between emotional regulation and thermoregulation, sympathovagal disturbances affecting a dog's ability to regulate fear and anger may be expressed in the form of temperature changes. In addition to temperature, other pill-sized sensors might be developed to measure stomach acid content (a stress measure) and other relevant biochemical changes affecting the gut in association with stress. Movement and general activity levels can be tracked and quantified by pedometers.

However, what is really needed is the ability to monitor simultaneously the activity of several relevant physiological parameters to establish a signature profile or configuration of specific physiological arousal states that are unique correlates of the target problem behavior. In addition to heart rate, devices measuring activity levels, respiration rates, skin potential, changes in muscle tone, and temperature, perhaps incorporated into a collar worn by the dog and receiving signals directly from the neck and from a vest containing ambulatory monitoring equipment, might be designed to track prominent autonomic changes in anticipation of aggression. In the case of dogs that give little or no advanced warning before reaching a flash point of no return, such devices might help to identify specific markers that regularly precede aggressive episodes and help to facilitate behavior-therapy efforts. Canine biofeedback collars might be programmed to automatically deliver various sensory stimuli to interrupt the aggressive sequence at an early and flexible stage or to provide the trainer with radio-controlled means to activate stimulation, perhaps involving attention-stimulating auditory stimuli, the delivery of odors that can increase parasympathetic tone at the critical moment,

and various other stimuli able to interrupt the aggression sequence and to induce behavioral inhibition. Electronic training collars incorporating biofeedback capabilities might be useful in the treatment of numerous behavior problems.

AUTOSHAPING AND AUTOMATED TRAINING

The full-body restraint and passive-exposure apparatus and techniques described by Williams and colleagues (2003) require little involvement of the owner or behavior therapist. The dog is simply put in a box, covered completely in a material that prevents movement and slowly exposed to the approach of a target or person. It is easy to imagine how such a technique might be further automated. Electronic products of various kinds are reportedly being developed with the goal of getting dogs to train themselves. Dunbar (2000) has dubbed the methodology *autoshaping*, borrowing the term from an experimental procedure in which laboratory animals are trained to manipulate levers and switches to obtain food reinforcement without the experimenter's aid. Dunbar predicts that autoshaping will revolutionize the way dogs are trained: "Electronics can train a dog by a flick of a switch overnight. The autoshaping revolution will be mind boggling" (transcribed). In addition to electronic collars emitting low-level electrical pulses, devices that Dunbar calls *tickling collars* and other electronic control devices designed to distract dogs in various ways will be programmed to interrupt and shape behavior automatically, presumably with the aid of a programmable food-delivery mechanism. Although autoshaping procedures and environmental programming may eventually offer significant applications for the control and management of certain behavior problems, in principle such procedures and goals are problematic with respect to the objectives of cynopraxic training and therapy. Certainly, owners lacking sufficient time or incentive to train their own dogs will be attracted by quick-fix devices offering effortless overnight gratification; however, nothing can ultimately take the place of the interactive and shared experience of training. Ironically, even designers of robotic pets have recognized the importance of interactive training to make entertainment robots seem more natural, gratifying, and pleasant (Kaplan et al., 2002):

> One of the challenges and pleasures in keeping a real pet, like a dog, is that the owner has to train it. A dog owner is proud when he has the impression that his pet changes its own behavior according to his teaching. We believe this is also a way for an interesting relationship to emerge between an entertainment robot and its owner.… This paper focuses on a method for teaching actions to an animal-like entertainment robot. Of course, the simplest way would be to allow the owner to program directly new actions for the robot. But for the purpose of entertainment robotics it would be much more interesting if this teaching would take place only through interactions, as it does with real pets. (197)

According to the authors, programming robotic dogs to behave in predetermined ways, without giving the user the ability to change a robot's behavior through training, significantly diminishes the potential fun and gratification derived from interacting with such pet toys. If automatic control is not satisfying for the users of robotic toys, how much less gratifying would autoshaping techniques be for the owners of sentient dog companions. By excluding the owner from the training process, autoshaping risks causing the dog to become progressively mechanized and detached from the owner as a source of predictability and control. Instead of enhancing the bond and the dog's quality of life, such products and techniques may serve only to reduce and constrict the human-dog bond while further alienating the dog from the home and family. Indeed, as a dog becomes an automated household accessory, one may gradually need devices to record and evaluate the dog's progress and emotional state. One such device, called a *Bowlingual* (Takara Corporation), may already be here (Tham, 2002). If it lives up to its maker's claims, the device would nicely fit into the futuristic autoshaping scheme. The collar device is equipped with a wireless microphone to pick up and

transmit vocalizations to a receiver that interprets the bark, howl, whine, yelp, and so forth into a literal translation of how the dog feels and projects it on a small terminal screen (e.g., "I'm sad"). In addition, the device can record vocalizations when the owner is not at home, providing a summary of the dog's emotional state and mood during the day.

Numerous electronic devices are currently available for monitoring and interfacing with dog behavior via various means of radio- and behavior-activated stimulation. Inexpensive noise-activated recorders and movement-sensitive video cameras provide extremely useful baseline and treatment-tracking information. Many of these devices have been previously discussed in the context of controlling destructive behavior (see Chapter 2). The most frequently used deterrent interface typically involves noise stimulation via booby traps and alarms activated by infrared or movement/vibration detectors. Such devices can be highly effective for controlling many nuisance problems, but the suppressive effect of loud noise for many dogs is problematic, especially with respect to the control of highly motivated behavior. Although initial exposure to a loud noise stimulus evokes pronounced startle, repeated exposure typically results in gradual habituation and loss of aversion. Further, dogs possessing high-startle thresholds may require noise stimulation at a level of intensity that potentially risks doing physiological harm to the ear (e.g., a nautical horn) (see Campbell and Bloom, 1965).

PART 2: ELECTRONIC TRAINING

Note: Throughout the following discussion, the terms used to describe electronic training collars (e-collars) and electrical stimulation (ES) are self-explanatory or specifically defined, as needed. However, one terminological decision requires some explanation to head off potential confusion. Specifically, the term *electrical stimulus* or *e-stimulus* has been selected to replace the word *shock*. The term *e-signal* is used in cases where a dog has learned to respond to the e-stimulus as an avoidance cue. There are several reasons for this decision. First, at low levels, the term shock is hardly fitting to describe the effects produced by electronic training collars, since there is virtually no effect beyond a pulsing tingling or tickling sensation on the surface of the skin. Second, the word shock is loaded with biased connotations, images of convulsive spasms and burns, and implications associated with extreme physical pain, emotional trauma, physiological collapse, and laboratory abuses. Third, the e-stimulus or signal generated by most modern devices is highly controlled and presented to produce a specific set of behavioral and motivational responses to it. In general, the terms e-stimulus, e-signal, and ES have been decided on for the sake of neutrality and because they more accurately describe the low to medium electrical events produced by radio-controlled and behavior-activated e-collars. In most cases where historical research has referred to ES as shock, the original terminological convention is maintained.

Currently, the most common aversive interface and deterrent used in dog training is ES. The use of electronic training devices is the subject of significant controversy and the propagation of misinformation and exaggeration on both sides of the debate. Historically, dog trainers working with hunting dogs were the primary end users of commercial electronic training collars. These early collars reputedly generated a harsh shock, causing significant pain and distress to dogs. In addition to producing a highly aversive shock, these early devices were prone to significant reliability problems, such as discharging in response to extraneous radio signals. In contrast, the safety and reliability of most modern electronic training and behavior-control devices have been significantly improved. Most current devices deliver a highly controlled e-stimulus, ranging from low levels of stimulation (imperceptible or just barely perceptible to human touch) to higher levels capable of causing significant startle and discomfort. High-quality contemporary devices enable trainers to select stimulation levels that precisely match a dog's needs, tolerance for ES, and training objectives, thereby prevent-

ing excessively painful stimulation and unnecessary distress.

The combined advantages of immediate and reliable radio-controlled delivery of precisely regulated ES make electronic training a viable and humane alternative to many traditional techniques for applying negative reinforcement and punishment. Traditional techniques can be effective when skillfully used, but they are often encumbered by undesirable side effects associated with interactive punishment, poorly regulated force, and retroactive timing. Finally, although potentially capable of producing significant psychological distress and harm when used improperly, electronic training devices are relatively safe and humane when used competently and selectively. Recently, the Delta Society, in cooperation with dozens of nationally recognized dog-behavior and welfare experts, has produced a document outlining professional humane standards for the dog-training profession. Both radio-controlled and behavior-activated electronic devices have been recognized as effective and humane training equipment when used properly and in accordance with humane principles (Delta Society, 2001). Given the potential benefits of radio-controlled electronic training and the relatively safe nature of ES, professional dog trainers are well advised to master the basic technical knowledge and behavioral skills needed to use such tools effectively and humanely.

Today, a variety of products are available over the counter for purchase and use by ordinary dog owners possessing little behavioral knowledge or understanding of the benefits or potential harm that can result from the improper use of electronic training equipment. Obviously, for proper and humane use, electronic training devices require support instruction and knowledge of basic-training principles; nonetheless, large numbers of radio-controlled e-collars are sold in pet stores to relatively naive and inexperienced dog owners without much in the way of appropriate instruction regarding their use, misuse, and potential for abuse. Unfortunately, the instructional material typically packaged with these powerful training tools is woefully inadequate. This neglect poses a significant welfare concern that should be addressed by responsible manufacturers and distributors of these products. Without proper instruction and guidance, electronic training collars cannot be used competently and humanely, and, in the hands of misinformed or incompetent users, e-collars can all too easily become instruments of abuse and cruelty. Of course, a similar criticism can be made concerning many other training collars and tools commonly used in dog training. Nevertheless, the radio-controlled and push-button operation of electronic devices poses special problems that justify additional concern with respect to misuse and potential for abuse. Furthermore, with promises of rapid control and instant gratification, impatient and unknowledgeable dog owners may resort to electronic training as a push-button panacea, without first giving conventional reward-based training methods a chance to succeed. Lastly, since there is considerable variation in the ES produced by e-collars, manufacturers should freely disclose critical information concerning the output of their collars, including open-circuit voltage, closed-circuit voltage, current and power, and pulse and waveform characteristics (pulse duration and pulse repetition rates), together with explanations regarding the significance of such specification in order to help consumers and professionals select devices best suited to their needs. Sadly, most of the manufacturers that the author contacted for information concerning output specifications either did not reply or were strangely evasive and uncooperative, arguing that such data were of a proprietary nature. Of course, all the needed electrical output and waveform information needed can be obtained with an oscilloscope. Further, reasonably accurate output comparisons can be obtained with a true RMS multimeter. Many of the details regarding circuit design and output specifics can also be obtained by consulting patent claims.

Although low-level electrical stimulation (LLES) is humane and highly effective, electronic training devices should not be used in the absence of reward-based training, nor should they become a crutch or a way of life. Success in electronic training is achieved when it is completely replaced by reward-

based training efforts. As a humane process, cynopraxic training strives to enhance affection, mutual appreciation, and trust between people and dogs, steering the relationship toward the ideals of interspecies cooperation and interactive harmony. Training is a lifelong process of befriending the dog—a process of mutual understanding and care that is most fully and satisfyingly achieved through gentle and considerate means. Excessive reliance on aversive procedures for controlling a dog undermines the attainment of these goals and risks damaging the relationship. Ultimately, the value of electronic training is measured by its ability to limit or extinguish itself, while at the same time liberating the dog from unacceptable behavior impeding a more enriched and rewarding life experience with people. Unfortunately, just as electronic training offers many significant benefits, it is fraught with significant risks of abuse and misuse. Instead of being used as a humane tool for enhancing the human-dog bond and improving a dog's quality of life, electrical control may be abused to enslave a dog by means of fear and pain. Using electrical control procedures to dominate a dog for the sheer sake of domination and exploitation is offensive and violates human sensibilities and the goals of cynopraxic training. Of course, similar concerns and considerations should guide the use of all aversive techniques used in dog training and behavior therapy.

Technical Considerations

Electrical Potential, Current, and Power

The relative potential of ES to produce pain or distress depends on a number of variables that are often ignored or underappreciated. Putting aside individual differences and psychological factors (e.g., the predictability and controllability of the event), parameters such intensity, frequency of application, duration, and location of ES figure prominently into the sort of experience that bioelectrical stimulation produces (Price and Tursky, 1975; Sang et al., 2003). The e-stimulus is focused on a circumscribed area of skin tissue located immediately beneath and between the electrodes, referred to as the *electrode-skin interface*. Because e-collars are designed to limit arcing, both electrodes of the stimulator need to make close contact with the skin to establish a closed circuit. Separation of electrodes from a dog's skin by thick hair or air of a distance greater than 1 millimeter will result in an open circuit. The high-voltage arcing of modern e-collars is minimal and may require magnification and darkened surroundings to view.

When discussing the effects of ES, some care should be exercised not to confuse electrical categories or phenomena. A common error is to equate voltage with current. Electrical potential or *voltage* is relative and depends on the electromotive difference between two points, whereas *current* refers to the amount of electrical charge or amperes flowing between those points over some period. The electrical quantity of a current is measured in coulombs (C), whereby 1 ampere (A) equals a flow of 1 C per second. A Van de Graff generator produces in excess of 300,000 volts (V) of electrical potential (the equivalent of a stun gun) but is relatively harmless to touch. On the other hand, as little as 25 V can be lethal to a person. The critical factor is the amount of energy (joules) or power that flows through the body. When one scuffs along on a carpet, the body accumulates a charge of several thousand volts, and voltage levels may rise to 3000 V or more when getting out of a car. Nevertheless, the energy released is miniscule, something on the order of 0.005 joules (J). The output of an e-collar tested by the New Zealand Department of Scientific and Industrial Research (Dix, 1991) was found to produce 3000 times less electrical energy than that allowed by standards for electrical fences, six times less electrical energy than that produced by the static discharge produced by walking on a carpet, and 50 times less than what is considered necessary to reach pain thresholds. Although the collar was estimated to produce a peak open-circuit amplitude of 961 V, when a current was passed through a 500-ohm load (simulating the electrode-skin circuit), a peak voltage of 58 V was found to drive a current of 116 milliamperes (mA) for 0.78 milliseconds (msec). When converted into energy values, the foregoing output current at peak amplitude and

duration was determined to be on the order of 1.2 millijoules (mJ). Kouwenhoven and Milnor (1958) demonstrated that extremely brief low-energy (0.0001 to 2.4 J) high-voltage shocks of 40,000 V in anesthetized dogs could not induce ventricular fibrillation, cardiac arrest, or "any other untoward effect" (45).

The following analogy may help to clarify some important distinctions between voltage, current, and resistance. Imagine a scenario involving subway train and two conductors. The first conductor forces passengers (electrons) into a train car while his twin pulls them off again as quickly as they board. The force that the first conductor uses to push the passengers on board will depend on the size of the entryway and any obstructions blocking the flow of passengers within the train itself. Similarly, the force used to pull the out passengers again will depend on internal resistance and the size of the exit (out-circuit impedance). To the extent that both conductors push and pull the passengers (electrons) in and out of the train, a current or flow of charge is established between them, without either of the conductors actually entering the train themselves. As such, voltage can be described as the pressure or force needed to cause a current of electrons to flow between two points of a closed circuit; *voltage* always implies difference and distance, whereas *current* implies movement and time. A current of electricity is conducted through the electrode-skin circuit at a certain rate or amperage depending on the combined resistance and capacitance (impedance) of the conducting circuit. The various relationships between voltage (E), resistance (R), and amperage (I) are derivable from Ohm's law: $E = IR$. For example, provided that one knows the amperage and resistance of a circuit, one can then calculate the voltage by multiplying the values together. For example, a 20-mA current requires 14 V of electromotive force to move through a circuit having a 700-ohm resistance. Similarly, by dividing the known voltage by the circuit resistance or load ($I = E/R$), the amperage can be obtained. The amount of electrical energy used by a circuit as a current passes through it is described in terms of temporal and heat units (e.g., amperes, watts, and joules).

When authors make statements about radio-controlled stimulators delivering shocks at a level of 3000 V, the reader may picture an event quite different than what actually occurs. The practice is doubly problematic when open-circuit and closed-circuit categories and measures are mixed together. The voltage between two electrodes of an open circuit may equal several thousand volts, and e-collars may generate open-circuit voltages of 3000 to 10,000 V, but one cannot sense the open-circuit voltage even though an electrical field radiates between the two electrodes of an activated e-collar. The open-circuit voltage is expressed as the difference in charge, electrical potential, or electromotive force between the electrodes. Without knowing other variables, however, such as the total impedance of the electrode-skin circuit, the amperage of the current, and the duration of the electrical event, the open-circuit voltage of the collar is not very meaningful information with respect to estimating the intensity of the e-stimulus reaching a dog. Referencing the open-circuit voltage may lead to unjustified connotations of severity. Christiansen and colleagues (2001a), for example, have claimed that the e-collar they used to suppress predatory behavior delivered an astounding 3000-V shock at 0.4 A. The notion that electronic training collars generate a 3000-V shock at 400 mA is misleading and must be wrong, since doing so for a 1-second period, as reported, would generate an astounding 1200 J of electrical energy—enough energy to light twelve 100-watt (W) light bulbs for 1 second. The authors appear to confuse the electrical potential between electrodes of an open circuit with the voltage between electrodes establishing a closed circuit—only a closed circuit can produce a flow of current capable of producing electrical power. With the current density localized around the small-diameter steel electrodes, such levels of shock as described by Christiansen and colleagues would likely seriously damage the skin. Finally, even though a particular e-collar may generates an open-circuit electrical potential of 3000 V, the actual operational voltage driving current through

the electrode-skin circuit is far less. According to Ohm's law, an e-collar set to produce a current of 12.8 mA through a 100-ohm load would require a voltage of 1.28 V. The same current flowing through a 1000-ohm load requires 12.8 V. These predictions obtained from Ohm's law are closely reflected in actual measurements obtained with a true RMS digital multimeter (Extech 22-811). The voltage output or amplitude of a popular e-collar driving the aforementioned current value (12.8 mA) through 100-ohm and 1000-ohm loads was measured at 1.27 V and 10.3 V, respectively.

To avoid some of the confusion that occurs when the output specifications of collar devices are reported in the scientific literature, it would make sense to report such information in terms of closed-circuit values based on some load constant (e.g., 700 ohms) or in terms of a power-output formula (Forbes and Bernstein, 1935). Power or watts is the rate of energy dissipated over some period. In a closed circuit, the amount of electrical energy produced is based on volts, current, and time (t): energy = t(EI), and 1 W is equal to the use of 1 J of energy per second. Consequently, power (P) is derived from the collar's voltage (E) times its amperage (I), or P = EI, making it a potentially useful value with respect to estimating the stimulation effect of an e-collar's output. In addition to quantitative parameters (e.g., current density and power), the subjective sensation produced by the e-stimulus is strongly affected by its waveform. The pulse duration and pulse repetition rate (frequency) are major determinants of the relative aversiveness or intensity of a current at a given amplitude flowing through the electrode-skin circuit. Keeping current and impedance constant, the subjective effect of the e-stimulus can be strongly affected by changes made to the pulse duration and pulse repetition rate (frequency), with longer pulse durations and increasing repetition rates producing more aversive effects (Kaczmarek et al., 1991). Many e-collars appear to shift intensity levels by altering the pulse duration or repetition rate while keeping the output current and voltage relatively constant, depending on the electrode-skin load. In such devices, the pulse amplitude (voltage) is less important with respect to the actual intensity of the e-stimulus produced. Although an oscilloscope is needed to graphically display the various changes in pulse amplitude, duration, and repetition rates, a multimeter can be used to get a general idea of the relative pulse duration at different levels of intensity via frequency and duty-cycle readings. The *duty cycle* represents the ratio of the pulse duration to the pulse period expressed as a percentage.

Electrode-Skin Interface: Resistance and Capacitance Factors

The combined resistance and capacitance of the electrode-skin circuit is referred to as its *impedance*. The impedance determines the amount of voltage needed to cause a current of electrical charge to flow through it; the higher the impedance is, the more voltage is needed to establish a flow of current. The voltage output of many e-collars appears to shift up or down in response to changes in fur and skin resistance, with an upper output limit set to prevent excessive discharge and heat-generative arcing. In addition, a current limiter is built into these devices to reduce the risk of malfunction and delivery of dangerous shock. These bioelectrical design features enable the device to compensate safely for individual impedance, thereby ensuring that a highly discrete and measured dose of ES is delivered, depending on the individual characteristics and needs of a particular dog. Brief doses (momentary), as commonly used to support avoidance training, typically require higher-amplitude stimulation to reach threshold values, whereas longer-duration (continuous) doses of ES appear to establish a circuit at a lower amplitude via ionic microenvironment changes localized around the electrodes, vascular dilation (Greenblatt and Tursky, 1969), and other changes conducive to reduced impedance (Sang et al., 2003). Continuous stimulation techniques enable a trainer to apply LLES effectively at levels that do not exceed the threshold values of A-beta sensory pathways (tickle and tingle effects).

The condition of a dog's coat and the outer layers of the skin (stratum corneum) are

the primary sources of cutaneous impedance. An important impedance factor is the skin's level of hydration, with dry and oily skin requiring more voltage than moist skin. Although skin moisture may improve its conductivity and increase the flow of current between electrodes (Chesney, 1995), external wetness may actually shunt current away from the electrode-skin interface and decrease current flow. Insulating the exposed sides of the electrodes with rubberizing paint may help to reduce current diversion due to wetness. Skin resistance varies between 10,000 to 100,000 ohms (or more depending on location) for dry skin and 1,000 ohms for skin that is well hydrated (Klein, 2000). The e-collar used by Tortora (1983) was reported to produce a pulse train having a 255-Hz repetition rate (50% duty cycle) with a peak voltage, measured across a 100,000-ohm load, estimated to be 1134 V. The high voltage of e-collars is designed to jump small gaps (1 millimeter) and pierce resistance barriers caused by bits of fur lying between the electrodes and the skin. Electrical arcing occurs when the electrode loses contact with the skin and the circuit is slightly opened. Relatively high voltage is needed to generate an arc between the electrode and a dog's skin. After the cutaneous resistance is transited by a brief high-magnitude pulse, skin impedance drops to a mean of 700 ohms (Kouwenhoven and Milnor, 1958). Measurements taken between internal and external electrodes have determined that the out-circuit impedance for dogs ranges from between 100 and 5000 ohms (Niwano et al., 2001). Subcutaneous resistance was measured to range between 95 and 225 ohms, whereas skin impedance at 10-V pacing showed significant variability, ranging from 460 to 16,600 ohms, depending on the size of the electrode used.

The impedance of the electrode-skin interface is also strongly influenced by the electrode diameter (Kaczmarek et al., 1991). Narrow-diameter electrodes require significantly more electrical potential to generate a charge that will pass through the skin (Forbes and Bernstein, 1935). In addition, since the current density concentrates at the out edge of the electrode, narrow-diameter electrodes, as used in e-collars, produce a highly localized and focused effect. The disadvantage of high-voltage ES is that the current density is established immediately beneath the electrode, which is prone to produce a pricking effect at levels just above detection thresholds (Kaczmarek et al., 1991; Poletto and Van Doren, 1999), perhaps in association with microscopic arcing around the outer rounded edge of the electrode, requiring great care to avoid eliciting pain when increasing stimulation amplitudes. In contrast, larger electrodes, as used in transcutaneous and neuromuscular electrostimulators, produce stronger ES intensity levels at lower pulse amplitudes and current levels.

The impedance load of the electrode-skin interface decreases as current increases, requiring less voltage at higher amperage levels, a principle applied to the design of transcutaneous electrostimulators. The cutaneous load also appears to be affected by the frequency of the pulse train (Rosell et al., 1988), with high-frequency pulses passing through the skin-impedance barrier more freely than low-frequency pulses. As pulse duration and pulse repetition rate are increased, the subjective magnitude of the e-stimulus is intensified. A major advantage of constant current devices is that they can shift the level of ES by altering the pulse duration or repetition rate rather than relying on changes to the pulse amplitude, thereby reducing the risk of discomfort generated by increased voltage in association with narrow-diameter electrodes. Many modern e-collars appear to hold pulse amplitude (voltage) relatively constant, altering output intensity by changing the pulse duration and repetition rates of the e-stimulus. Other devices alter output intensity by increasing pulse amplitude and keeping pulse duration and frequency relatively constant, depending on the electrode-skin load. When skin resistance is low, pulse amplitude is decreased; whereas when skin resistance is high, pulse amplitude is increased. The high, medium, and low variations that are generated at different levels by some collars appear to be achieved by altering pulse duration and repetition rates rather than involving changes affecting output amplitude.

Threshold Values

Prior exposure to ES exerts a number of modulatory influences over electrocutaneous thresholds, with experienced human subjects tolerating at least twice the electrical intensity tolerated by naive subjects (Kaczmarek et al., 1991). Although long-duration ES results in a reduction in cutaneous impedance, it is also associated with stimulus fatigue and a reduced sensitivity to the e-stimulus (Tursky et al., 1970). Consequently, low-level continuous stimulation used in the context of attention training may help to elevate reactive thresholds, thereby reducing the risk that medium-level ES will evoke adverse arousal. The presentation of brief nonpainful prepulses of ES also serves to elevate pain thresholds. Studies with human subjects have shown that presenting a 0.5-second prepulse of ES 40 to 60 msec before a stronger ES serves to reduce pain thresholds significantly (Blumenthal et al., 2001). In persons with low-pain thresholds, 40-msec prepulses of current set to match perceptual threshold levels resulted in a 54% reduction in perceived pain. Presenting a vibratory stimulus to dogs just in advance of the electrical event (60 to 300 msec) appears to help reduce startle arousal while at the same time facilitating the integration of the event as an informative signal via sensorimotor gating processes. Another useful technique for reducing the risk of reactive responses in dogs with low thresholds is to introduce ES gradually in combination with a continuous vibratory stimulus overlapping the e-stimulus.

Surprisingly little data have been reported about dogs with respect to electrical threshold values. What little is known suggests that the thresholds for shock produced by high-voltage generators (approximately 500 to 600 V at 60 Hz) do not significantly differ between puppies and adult dogs (Lessac and Solomon, 1969). The minimum electrical intensity required to evoke a leg flexion for both puppies and dogs was found to be around 0.80 mA (range, 0.50 to 1.25 mA). The yelp response in both young and adult dogs was evoked at approximately 2.80 mA (range, 2.0 to 3.0 mA). Brush (1957) found that the efficiency of avoidance learning increases with intensities up to 4.8 mA, with latencies to escape appearing to increase at intensity levels above 5.0 mA. The maximum electrical shock delivered to the feet without inducing tetany has been determined to be around 10.0 to 12.5 mA (Solomon and Wynne, 1953). These specifications are not of much relevance with respect to e-collars, however, since significantly more electrical amplitude is needed to reach the detection threshold in the case of narrow-diameter electrode devices than is required by the larger electrodes and grids used in the experimental setting. At 500 V, a sustained current of 6.0 to 8.0 mA passed through a narrow electrode, as used in e-collars, barely reaches detection thresholds; however, the same current applied through a 2-inch-diameter electrode produces extreme discomfort. Conversely, directing the lowest detectable current produced by an e-collar through a 2-inch electrode results in a highly aversive event.

Standardization and Safety Considerations

Although many advances in collar design and quality have been made over the past several years, there is a significant lack of product standardization. The quality of electronic training collars varies among manufacturers, but most provide the means to adjust the collar to deliver stimulation at low and medium levels, producing a tickling or tingling effect, as well as high level electrical stimulation (HLES) capable of producing significant pain and distress in most dogs. High-quality collars produce a smooth stimulus effect, whereas cheap and poorly designed devices tend to produce a rough and unpleasant sensation, even at low levels, making them inappropriate for cynopraxic training purposes. Unfortunately, many devices produce a high-end shock that *far* exceeds what is needed by the average dog and owner. Although an occasional dog may need the higher levels of stimulation, such devices should be made available only through special order. Alternatively, an electronic key or code might be inserted into the circuit of such devices that would keep the high-end off, at least until the user found a real need for it and requested the code from the manufacturer. Such owners could be given

appropriate counseling and referrals to trainers for further advice and instruction on how and when to use HLES. The ability to switch from low, medium, and high scales would provide the user with a greater range of output levels to meet specific needs and reduce the risk of accidental painful shock.

The high-end output of certain contemporary devices suggests the need for an optional safety device to prevent ES from occurring above a certain level and to prevent activation by unauthorized users (e.g., children). Accidental stimulation at high levels can produce significant distress and emotional harm to a dog. There is also a need for a product that would enable trainers to shape the e-stimulus according to specific needs. Devices that would enable professional users to set pulse amplitude, durations, and frequency (waveforms) as well as to control the duration of momentary stimulation and pulse-burst patterns would be highly desirable in the context of behavior-therapy applications. An external electrode interface might be designed to capture and condition collar output in various ways to make it safer and more compatible with low-level electrical training procedures. Meanwhile, the effective electrical output of an e-collar can be easily stepped down by placing an appropriate voltage divider (resistor) or miniature potentiometer between the electrodes. The lower the resistance is, the more voltage is shunted away from the skin. By carefully selecting a resistor with the correct ohm value, the entire output range of the collar can be adjusted down to low levels of ES, converting the strongest e-collar into a "tickle collar." The resistor wires should be appropriately sealed with nonconducting paint or sheathing. (*Note:* Users should check with the manufacturer for specific instructions and safety guidelines pertinent to such product modifications.)

Subjective Factors and Electrical Stimulation

Electricity is a basic force of nature and life itself, with electrical currents streaming along the double-helical strands of DNA (Boon and Barton, 2002) and mediating every sensory transmission and action of the body. Nerve cells communicate with one another through the exchange of minute electrical charges, thereby producing sensory feelings of pleasure and pain and all forms of neural activity and bodily movement from the most primitive reflex to complex thought processes and motor skills. Millions upon millions of electrical signals travel through the body unnoticed while serving critical biological and behavioral functions. Given the ubiquity of electricity, it seems odd that dogs and most other mammals have not evolved sensory receptors specifically dedicated to sensing electrical stimuli.

While a true RMS multimeter or an oscilloscope can give trainers useful technical information, the direct experience of the e-stimulus translates the quantitative specifications into a qualitative and subjective appreciation for the event. Knowing the electrical dynamics of the e-stimulus is helpful for many reasons, but nothing can replace the feel or subjective index of stimulus quality and magnitude—the most sensitive way to evaluate the e-stimulus is to feel it. The subjective experience of electricity arises from the activation of cutaneous mechanoceptors. When touch receptors are activated by noxious stimulation or injury, electrical impulses communicate to the brain that damage or a threat of physical injury has occurred. Although the e-stimulus used in dog training does not produce any physical damage to the skin or underlying tissue, its presentation produces an illusion of noxious stimulation by activating mechanoceptors transmitting tactile sensations along myelinated A-delta and A-beta fibers (Sang et al., 2003). At low-intensity levels, low-threshold myelinated A-delta fibers transmit tapping, tickling, tingling, twitching sensations, whereas, at medium levels, high-threshold A-beta fibers are triggered evoking sharp pricking and jabbing sensations. Higher levels of ES may activate high-threshold cutaneous and muscular C-fiber nociceptors and mechanoceptors associated with a burning sensation. The throbbing and burning aftersensations of painful trauma are transmitted by high-threshold unmyelinated C-fibers occurring as the result of physical

injury. Although no actual injury occurs, the reflexive actions elicited by aversive ES and the instrumental behavior emitted by dogs at such times are similar in many respects to responses occurring when physical pain is actually experienced (e.g., inhibitory startle and escape).

The advantage of ES is that it can be presented in highly controlled (intensity, duration, and density) and timely doses, producing corresponding levels of behavioral arousal, ranging from increased alertness and searching activity to intense startle and frantic escape efforts. Essentially, ES appears to confuse local mechanoceptors and nociceptors, causing the organism to respond as though a significant contact threat was present requiring immediate attention and escape. The e-stimulus is a purely subjective and psychological event. Tortora (1982) nicely states the aversive illusion produced by LLES:

> Safe electrical stimulation utilizes your dog's senses and causes your dog to respond as if there is physical damage, when in reality no damage is occurring. There is no better way to cause safe, timely, controllable short-term discomfort. (11)

Radio-controlled electronic training techniques can be divided into three general categories, depending on the behavioral objective and level of stimulation:

Low-level ES (LLES): escape/avoidance (negative reinforcement) and safety training
Medium-level ES (MLES): inhibitory training (punishment and negative reinforcement)
High-level ES (HLES): rapid suppression and aversive counterconditioning.

At low levels, the e-stimulus is annoying and disruptive; at medium levels, it is startling and inhibitory; and, at high levels, it can evoke significant pain and emotional distress. Although collar-produced shock can produce acute pain, the painful event does not and cannot produce physical injury. Pain is the subjective experience associated with somatic irritations and traumatic injury (e.g., stinging, throbbing, aching, or burning sensations). The experience of electrical pain is highly variable and not dependent on the activation of nociceptors specific to electricity; in fact, the mammalian somatosensory system appears to lack receptors specifically dedicated to electrical stimuli. Significant individual differences exist with respect to the dog's tolerance for electrical pain. In addition to the dog's temperament and relative threshold sensitivities to aversive stimulation, the subjective experience of pain is modulated by a number of variables, including stress, fear, frustration, and anger. Further, pain thresholds can be significantly elevated by the elicitation of incompatible emotional and motivational states associated with olfaction, food, sex, massage, affection, and the effect of person. On a neurophysiological level, the pain associated with strong ES is modulated to some extent by the secretion of opioid substances in the brainstem that interact with nociceptive signals (Johnson, 1998).

Although electronic training devices can produce significant pain and distress, the subjective effects of low to medium ES do not warrant the term *pain*, as defined by the International Association for the Study of Pain (IASP) (Merskey and Bogduk, 1994). The IASP defines pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (210). The standard set by the IASP clearly makes a distinction between stimuli producing momentary discomfort, but which are physiologically harmless, and states of pain resulting from actions leading to or having the capacity to produce injury: "Experiences which resemble pain but are not unpleasant, e.g., pricking, should not be called pain" (IASP, 2003). These distinctions appear to exclude the low-level to medium-level e-stimuli that produce a pricking sensation from being referred to as pain. As such, pain is subjective and depends on the evocation of an emotional state evidencing significant discomfort and distress.

Further, the physiologically harmless ES produced by e-collars should not be lumped with ordinary household electrical shock because the former has no potential for injuring tissue whereas the latter can produce physical injury, including severe burns. As such, the e-stimulus is not a priori a painful

event and can be applied to the skin without producing any pain whatsoever. The most interesting and useful applications of the e-collar involve stimulation levels at just above threshold levels—tickles, tingles, and twitches. Electrical stimulation producing pricking sensations is also used without generating significant pain or distress. In fact, the vast majority of training objectives using ES involve low and medium levels. HLES is reserved for aversive counterconditioning, often delivered in the form of extremely brief momentary pulses and used for such things as snake proofing and the suppression of predatory behavior.

Though dogs may find ES alarming at low levels and startling at medium-intensity levels, these stimulation levels are far less aversive or intrusive than many conventional corrections delivered by slip, prong, or halter collars. Even when ES is delivered at moderately high levels, the subjective sensation of momentary stimulation approximates the feeling of a standard-sized rubber band stretched 5 or 6 inches away from the skin and released sharply on the wrist. Repeated ES delivered to the human hand at various levels used for training purposes produces no redness and minimal lingering sensations of discomfort. Comparable stimulation with a rubber band results in significant irritation and redness, and aching persists. Traditional training collars and tools produce an aversive effect by various means, such as abruptly compressing or jabbing the neck (slip and prong collars), clamping around the muzzle and twisting the head and neck (halter collars), or sharply striking the dog's body (e.g., throw objects). All of these techniques are relatively safe and humane when used properly but could damage the throat or neck if misused or abused. Electronic stimulation, on the other hand, is distinguished by being relatively harmless with respect to producing physical damage to a dog's skin or body. Furthermore, since mechanical techniques work by forcefully stimulating mechanoceptors and nociceptors, such tools may cause local irritation or muscle strain. Unlike the aversive effect of ES, which rapidly dissipates after being discontinued, forceful stimulation of skin and muscle tissue can result in a chain of biochemical events that may cause sustained throbbing, local irritation, or bruising.

Anyone who has ever witnessed a dog experiencing acute (real) pain knows that they yelp repeatedly and show other autonomic and behavioral signs of sustained and unmistakable agony. The response dogs typically show in response to low to medium ES cannot be construed as pain. Dunbar (2000), during a panel discussion on dog-training equipment at the Tuft's Expo, acknowledged the capacity of "electronic stimulation collars" to produce a harmless and effective stimulus for training dogs, suggesting that such devices offer unique alternative for humane punishment:

> When you see an electronic stimulation collar working, then we need a different word for it, it's a "tickling collar" is what it is. And, you know, go to the companies; ask them, "Do you have anything that tickles me?" Put it on your hand, zap it out; so, I guarantee that we will have dog-friendly e-collars and autoshaping devices that do loads. They will be distracting dogs in all sorts of ways: with wisps of smells, uh, sounds that we can't hear, and maybe little tickles on the skin, and what have you. Then I think that the dog training area will start to come together, because you now have a greater choice of the punishments that you can choose on. And now, there is literally no need ever, ever to shock a dog. There, there's no need for it. No one can convince me of that. Why? Because we have the alternative, it's high tech, yeah, but it doesn't hurt. (transcribed from audio recording)

Just as dropping a bowling ball on one's foot will certainly produce a significantly different effect than that produced by a falling tennis ball, ES produces variable subjective and physiological effects, depending on the intensity of the stimulation used. To speak about the behavioral and emotional effects of electricity in general and biased ways is counterproductive. The objective effects of ES range from below-threshold to tetanizing and life-threatening shock. When referring to ES, an effort should be made to specify the sort of ES being discussed. Several basic categories are hereby proposed to guide future discussions:

Below threshold of perception
Mild tingling and attention (stimulus recognition)
Annoyance or tickling stimulation
Prickly startle reaction
Discomfort, distress, and escape arousal
Extreme pain and distress

Stress, Distress, and Potential Adverse Side Effects of Electrical Stimulation

Biological Stress and Psychological Distress

Learning is always distressful to some extent, with anxiety and frustration representing important incentives motivating adjustment, just as biological adaptation and the maintenance of stability in change (*allostasis*) are vitally dependent on a dog's ability to generate a stress response. Although stress and distress are not the same thing, some authors appear to treat these phenomena as though they were the same (see Schilder and Van der Borg, 2004). Just as physical exercise produces biological stress while building muscle mass and endurance, short-term stress in the context of training is not necessarily without robust long-term benefits. Psychological distress (anxiety, frustration, and startle) per se is not necessarily an impediment to learning, nor does it necessarily represent a threat to a dog's welfare (i.e., a state conducive to and promoting an adaptive coping style in response to an environmental challenge or threats). Distress is first and foremost a healthy response to an environmental challenge requiring an unaccustomed adjustment. Stress and distress only become problematic when they occur under social or environmental circumstances that prevent a dog from coping (adjusting or adapting) effectively—conditions that may result in various behavioral and biological disturbances as indexed, for example, by allostatic load and overload (Wingfield, 2003).

Dogs exhibit considerable variation in their response to ES. In addition to the electrical characteristics of the e-stimulus event, various behavioral and psychological influences exert significant modulatory effects on a dog's response to ES. Prominent among these influences are habituation, sensitization, and opponent processes (relief/relaxation). The genetic heterogeneity and variation, even among dogs of the same breed, confer upon them a highly variable capacity for coping with aversive stimulation. Vincent and Michell (1996) found, within a population of 227 trainee guide dogs, that 96 (42.3%) were stress prone, a propensity that correlated with a trend toward higher blood pressure and heart rate. Dogs exhibiting a heightened vulnerability to stress will likely respond to shock in a more reactive and stressful way than will dogs less prone to stress.

When coping with a threat or challenge, a dog may show variable signs of anxiety or frustration but become problematically distressed only if the situation proves uncontrollable, whereupon anxiety (the situation lacks predictability) may grow into fear or frustration (the situation lacks controllability) may escalate into anger or aggression. While mobilizing the flight-fight system (FSS), the sympathoadrenal-medullary system (SAM) helps to promote a state of arousal and bodily readiness to react to a situation perceived as dangerous and uncontrollable. A slower opponent regulatory system, the hypothalamic-pituitary-adrenal (HPA) axis, is brought into play by the action of corticotropin-releasing factor (CRF) on the pituitary, stimulating the release of adrenocorticotropic hormone (ACTH) into the bloodstream. ACTH acts on the adrenal cortex to stimulate the release of glucocorticoid hormones (e.g., cortisol), which perform a number of adaptive biological functions within the body and brain. As cortisol enters the brain, it counteracts the reactive emergency state of arousal and begins to restore balance by exerting a general calming effect, including a negative-feedback control over the release of CRF that in turn inhibits the release of ACTH, which in turn decreases the secretion of cortisol, as things are gradually normalized. With respect to the use of aversives in dog training, the dog appears to have evolved antistress and antinociceptive capabil-

ities that enable it to cope with such demands, perhaps mediated by a specialized oxytocinergic-opioid network (Panksepp et al., 1997; Uvnäs-Moberg, 1998) that enables it to cope (flirt and forbear) with significant psychological distress without prompting the activation of the SAM and HPA systems, provided that the distressing event is perceived by the dog as controllable. Dess and colleagues (1983) performed a series of experiments to evaluate the effects of event predictability and controllability versus event unpredictability and uncontrollability on plasma cortisol levels in dogs exposed to shock (7 mA for up to 15 seconds and 5 mA for up to 5 seconds). The dogs were divided into several groups, some of which could escape the stimulation, whereas others received shock regardless of what they did to escape from it. The researchers found that dogs that could control the occurrence of shock by escape exhibited a significantly attenuated cortisol response than did dogs having no control over the shock stimulus.

Among dogs, controllable aversive events may generate signs of temporary distress and precursor submission behaviors, but it is highly unlikely that such events rise to the sort of biological challenge or threat that might pose a significant threat to a dog's welfare or quality of life. Submissive precursor behaviors mediated by the corticobulbar social engagement system (Porges, 2001) are frequently mistaken for fear and evidence of stress. By carefully drawing lines between biological stress, quantified by changes in the release of adrenal steroids, and psychological distress, as indicated by autonomic changes (e.g., heart rate and HRV), one might avoid some of the confusion. Having a set of behavioral markers that might be used to assess biological stress would also be convenient, but until such behavioral markers have been properly validated, the use of ambiguous behavioral signs and ambivalent behaviors to index stress is fraught with the risk of subjectivism (see *Electronic Training and Working Dogs: A Shocking Study*). Beerda and colleagues (2000) have warned that ambiguous "stress behaviors" (e.g., subtle postural changes, oral displacement activities, paw lifting, yawning, and so forth) may lead to false interpretations, unless the behaviors can be closely tied to physiological markers of stress (e.g., cortisol). Salivary samples can be obtained within 30 seconds or so (Kobelt et al., 2003), making such minimally intrusive sampling convenient for verifying the presence of stress. Without physiological markers, the attribution of stress to ambiguous behaviors is unwarranted and interpreting them as indicators of stress lacks scientific support. Changes in cortisol appear to be useful for detecting long-term adverse effects associated with shock in training (Stichnoth, 2002) and may be revealing even in the absence of overt behavioral signs of stress (Vincent and Michell, 1992).

Stress, Traumatic Avoidance, and Laboratory Conditioning with Shock

Evidence for individual differences affecting the way dogs cope with the most severe and debilitating electrical shock has been reported by several researchers. Perhaps the most extreme of these studies was performed by Houser and Paré (1974), who subjected two dogs to a daily regimen of electrical conditioning for 6 months. The dogs were restrained in a Pavlovian hammock, with electrodes delivering a 0.5-second 4.0-mA shock every 20 seconds to a hind leg. Each daily session lasted 3 hours. The dog could avoid the shock and postpone it for 20 seconds, provided it performed at least one key-pressing response during the 20-second period. During the last 2 months of the study, a classical conditioning contingency was superimposed on the Sidman avoidance schedule just described, thereby significantly increasing stress. Every day for 2 months the dogs received seven unavoidable 8-mA shocks lasting 0.5 seconds that were preceded by a 3-minute conditioned stimulus (light). Bear in mind that the dogs had to keep track of the temporal avoidance contingency simultaneously while bracing for the repeated presentation of unavoidable shock. Aside from demonstrating that human ingenuity for cruelty knows no bounds, the study showed that dogs possess a profound adaptive capacity for coping with the most assaultive and stressful circumstances. A dog's

capacity to endure such laboratory conditioning is strongly dependent on individual differences, and the two dogs showed very different patterns of heart rate and cortisol release during the *300* hours of data collection.

Among psychological influences, the amount of control that a dog has over the aversive event directly affects the amount of fear and stress that it will likely experience when exposed to ES. For example, inescapable painful or traumatic shock may produce temporary and perhaps permanent debilitating effects on a dog's ability to cope competently with aversive situations, as well as stimulate a variety of stress-related physiological changes. However, generalizing to the notion that ES is debilitating per se is not justified by the relevant scientific literature. Under laboratory conditioning, dogs have demonstrated extraordinary capacities for coping with severe shock and other forms of traumatizing treatment (Solomon and Wynne, 1953; Kamin, 1954). A worker in Pavlov's laboratory trained a dog to salivate and to show negligible signs of defensive behavior or cardiovascular distress by pairing increasing levels of shock with food, gradually reaching levels of intensity sufficient to burn the skin, emphasizing the extraordinary adaptability that dogs exhibit with respect to electrical shock arranged to predict appetitive gratification:

> The conditioned food reflex was elaborated not from an indifferent agent but from a destructive one evoking an inborn defensive reflex. The skin was irritated by an electric current and at the same time the dog was fed, although at first the feeding had to be forced. A weak current was applied which was later increased to the maximum. The experiment ended thus: with the strongest current, as well as with burning and mechanical destruction of the skin, there could be provoked only the food reaction (the corresponding motor reaction and the salivary secretion) and there was no trace of any interference by the defensive reaction, there were no changes in breathing or heart beat, characteristic of this last reaction. (Pavlov, 1928:341)

The critical issue at stake appears to be the degree of perceived control that the dog has over the aversive event. In the case of classical conditioning where food is associated with shock, the dog may perceive the shock as a controllable event contingent upon it waiting for some brief period after which the shock ends (safety) and food appears (comfort). The loss of control over aversive stimulation appears to increase the risk of inducing problematic cognitive, emotional, and behavioral effects. Littman and colleagues (1964) exposed rats of different ages to five sessions (each at 1 mA for 3 minutes) of continuous inescapable shock and found that shock thresholds and latencies for escape were significantly increased when traumatized rats were tested 1 day later. The adverse effects of uncontrollable trauma were still evident after 2 months.

When Seligman and Maier (1967) exposed dogs to escapable and inescapable shock to test various hypotheses regarding the effects of event controllability and uncontrollability on avoidance learning, they found that adverse cognitive and emotional interference effects and learned helplessness were primarily exhibited by dogs that lacked control over shock, whereas dogs with control over shock were less disturbed by the experience. A yoked design resulted in both groups of dogs receiving identical stimulation, except that the dogs under the escapable shock condition could terminate shock by pressing a panel located next to the head, whereas the dogs in the inescapable group had no control over the shock event. The dogs were restrained in a Pavlovian hammock with holes cut out for their legs, which were immobilized by cords lashed above the feet and tied to the floor. The only difference between the two groups was that dogs in the escapable group could terminate shock by pushing a panel located next to the head. The inescapable group received 64 shocks (6.0 mA), at 5 seconds each, delivered to the pads of their hind feet. During subsequent escape testing, both groups were exposed to 10 trials in which a 10-second conditioned stimulus was presented (a dimmed light), followed by 50 seconds of "severe pulsating shock" (1969:322). The intertrial interval varied from 60 to 120 seconds.

Approximately two-thirds of the dogs (N = 82) previously exposed to inescapable shock showed evidence of impairment in their ability to initiate escape behavior. Dogs that failed to jump over the barrier could be taught to overcome the interference effects of inescapable shock by being repeatedly pulled over the barrier by leash, gradually learning (some requiring 50 trials) to hop over it with the slightest tug and finally do so on their own (Seligman et al., 1968). If the dogs were allowed to rest for 48 hours prior to escape testing, these dramatic interference effects were not observed despite repeated exposure to inescapable shock (Overmier and Seligman, 1967). However, if the inescapable exposure was repeated, more durable interference effects were observed. Seligman and Groves (1970) showed that dogs with a variegated history of prior exposure to aversive stimulation had a greater resistance to the adverse effects of inescapable shock, requiring four blocks of 64 trials in which 5-second shocks were given on each trial for a total of 1280 seconds of exposure to shock in order to establish learned-helplessness effects. In contrast, cage-reared dogs showed a greater susceptibility to escape impairments, requiring two blocks of 64 trials in order to show enduring learned-helplessness effects—lasting at least a week. Caged dogs may receive insufficient opportunities to acquire coping skills, making them more vulnerable to the adverse effects of uncontrollable aversive stimulation. Lessac and Solomon (1969) found that severe isolation lasting for 1 year resulted in escape/avoidance behavior resembling learned helplessness—deficits that were prevented by electrical escape/avoidance training at week 12.

Electrical Stimulation Controllability and Safety

A large body of scientific evidence supports the notion that opponent poststimulation relief and relaxation is an important motivational aspect of escape/avoidance learning. The immediate effect of ES termination is emotional relief, which is subsequently followed by opponent-relaxation effects that develop more sluggishly and automatically over the next 2 to 3 minutes (Denny, 1991). As a result, the cessation of a controllable e-stimulus or its avoidance appears to promote hedonic emotional changes conducive to reward and safety (Denny, 1971). Further, conditioned stimuli associated with shock (S1) or the absence of shock (S2) have been shown to promote differential behavioral changes consistent with the safety hypothesis (Rescorla and LoLordo, 1965) (see *Safety Signal Hypothesis* in Volume 1, Chapter 8). While performing a Sidman avoidance task, dogs increased avoidance responding while in the presence of the excitatory S1, whereas they decreased avoidance responding when the inhibitory S2 was presented. Using a paradigm of classical conditioning similar to that employed by Rescorla and LoLordo, Billman and Randall (1980) confirmed that discriminated excitatory (paired with shock, S1) and inhibitory (not paired with shock, S2) conditioned stimuli also exert a differential effect on cardiovascular activity consistent with preparatory aversive arousal/threat and relaxation/safety effects, respectively. The signaled cessation of shock and partial reinforcement in dogs has also been shown to produce conditioned changes in heart rate consistent with the safety hypothesis (Fitzgerald, 1966; Royer, 1969). Finally, basic learning research with rodents (Galizio, 1999) appears to support the notion that stimuli predicting safety from shock (S2) acquire persistent reward properties that continue after extinction of the avoidance response has occurred. Poststimulation relief and relaxation has been successfully used to treat avoidance-motivated aggression in dogs (Tortora, 1983) and other refractory canine behavior problems (e.g., aggression toward strangers and other dogs) (Schwizgebel, 1992). In combination, the foregoing laboratory work supports the notion that safety in association with the successful escape/avoidance of aversive stimulation may augment the value of social rewards (e.g., petting and praise) used by the trainer to support cooperation and obedience to command. Properly performed electronic training promotes a confidence-building pattern of escape to safety that can be highly beneficial and useful in the context of canine behavior therapy

(see *Escape to Safety versus Escape from Danger* in Chapter 8)

Electrical Stimulation Technology

Electrical stimulation has been used in various ways to influence motivation and behavior. In medicine, ES is used to aid in the control of heart problems, ranging from defibrillators resuscitating a lost heartbeat to pacemakers helping to maintain the heart's rhythm. Intracranial electrodes implanted in various parts of the dog's brain have been used to monitor and modify brain electrical activity and behavior (Himwich et al., 1965; Wagner et al., 1967). Vagal nerve stimulators have been successfully implanted and used to control seizure activity in dogs not responsive to anticonvulsant medication (Munana et al., 2002). Theoretically, certain intractable aggression problems or compulsive disorders associated with sympathovagal dysregulation or temporal seizure activity might benefit from vagal nerve stimulation (VNS), but to my knowledge such devices have not been evaluated for the control of serious canine behavior problems.

The use of ES on the skin has several applications in medicine. ES has been successfully used in acupuncture, as well as other applications for the control of pain, such as transcutaneous electrical nerve stimulation (TENS). Medical stimulators have also been developed to improve muscle tone via high-voltage constant-current stimulation. Several groups of bioelectrical engineers have been working for many years on sensory-substitution applications using electrocutaneous stimulation (ECS) and vibrocutaneous stimulation. These devices are aimed at assisting blind or deaf users or those needing to use prostheses (Kaczmarek et al., 1991). The modern e-collar has benefited significantly from these research and development advances in ECS technology. Perhaps the most common and controversial scientific use of ES has been in the contexts of the learning laboratory (Solomon and Wynne, 1953), aversion therapy (McGuire and Vallance, 1964), and behavior-modification programs (Lovaas et al., 1965; Lovaas and Simmons, 1969). Researchers investigating fear and pain have also made considerable use of ECS (Tursky, 1973). In combination, many hundreds of studies have been dedicated to the sensory, autonomic, emotional, and behavioral effects of ES for motivating and controlling behavior (Campbell and Masterson, 1969), making ES the most carefully and exhaustively studied aversive stimulus available for use by dog trainers. An early radio-controlled device designed for laboratory conditioning with dogs used a harness-and-collar arrangement. The collar produced a 30-mA current (1000-V peak amplitude output) delivered through electrodes positioned on the dorsal surface of the dog's neck (Caldwell and Judy, 1970). One of the earliest radio-controlled devices explicitly designed for dog-training purposes appeared in the 1950s (Cameron and Hopkins, 1955). The radio-controlled receiver delivered a high-voltage, low-amperage current of electrical charge to the shoulders of the dog via electrodes fastened to a harness. The device produced one level of stimulation and was designed primarily to punish undesirable behavior.

Numerous electronic training aids have been developed in recent years incorporating a mild electrical or spray stimulus (e.g., aerosol citronella) to modify dog behavior. These devices can be divided into two general categories, depending on whether they are activated by a trainer controlling a radio transmitter or directly activated by the dog's behavior. Radio-controlled electronic devices are used to deliver various signals (e.g., tones, clicks, or vibrations) and aversive stimulation via a receiver attached to the dog's collar. Activation of the collar is controlled by a hand-held transmitter that provides the trainer with precise control over the presentation of both conditioned and unconditioned aversive stimuli at a distance. In addition, some collar systems include a reward tone or click that can be paired with successful escape/avoidance or the presentation of appetitive-positive or social-positive reinforcement (e.g., food or petting). Most current products permit the user to adjust the level of stimulation from a nearly imperceptible level or annoying tingle

or tickle to a strongly aversive prickly twitching sensation.

Behavior-activated electronic training collars are most commonly used in applications involving outdoor containment and the control of excessive barking. Unlike radio-controlled electronic training aids, behavior-activated collars are not dependent on the presence of a human operator. In the case of containment systems, both conditioned (warning tone) and unconditioned (electrical or spray) stimulation are delivered automatically as the dog approaches an underground wire that encircles the property. The wire boundary forms a closed loop with a circuit box that transmits a radio signal to the receiver collar worn by the dog. Whenever the dog approaches within a certain distance (approximately 2 to 10 feet) of the boundary line (warning-signal field), a tone stimulus is activated that is immediately discontinued if the dog backs away; however, if the dog encroaches further into the warning field, an aversive electrical or spray stimulus is delivered. In the case of bark-activated e-collars, a microphone or a vibration sensor that makes contact with the dog's neck closes a circuit causing the collar to deliver a brief e-stimulus. Another device that has become popular with some trainers and behaviorists in recent years uses aerosol citronella sprayed from a collar. When activated by barking, the solenoid valve releases an aerosol spray directed up toward the dog's head. Unfortunately, the velocity of spray flow and the intensity of the odorant delivered cannot be adjusted to meet specific training needs. The device does, however, allow the user to deliver a short or long spray stimulus.

Many other electronic devices are in use to control dog behavior. These gadgets include electronic systems designed to protect specific areas of the house against intrusion or destructiveness. One device, used to protect furniture and other surfaces in the home, delivers static shock via an electrified mat. Other devices depend on the generation of loud audible and ultrasonic sounds to deter various actions. Some devices emit a loud high-pitched tone that is activated by motion, body heat, or vibration. After a variable period (ranging from 2 to 20 seconds), the sound stimulus shuts off and resets. Although loud auditory stimulation appears to work well on certain problems, ultrasonic devices do not appear to be as efficacious (Blackshaw et al., 1990). In comparison to electrotactile stimulation, loud sounds appear to be significantly less aversive (Campbell and Bloom, 1965).

Radio-controlled Electrical Stimulation

Over the past decade or so, electronic training has become increasingly popular among dog trainers for establishing increased control and reliability when a dog is off leash and for treating a variety of behavior problems. The wide acceptance of electronic tools by the dog-training community has been in part the result of significant design improvements in the size, adjustability, reliability, and safety of e-collars. Electronic devices are also becoming increasingly affordable. The e-collar's ability to deliver a consistent and precise ES at a distance makes the device extremely attractive and useful. Recently, relatively inexpensive collars have come to the market that are small, lightweight, and loaded with sophisticated features, including the ability to increase or decrease the level of stimulation from the transmitter instantly and in real time by turning a dial. This feature enables a trainer to accurately match the stimulation level to an individual dog's sensitivity and temperament. These electronic training collars deliver a relatively consistent and measured level of aversive stimulation, ranging from a tickle, tingle, twitch, or prickly twinge to a highly aversive electrical event that produces significant discomfort and startle but without risk of producing physical injury or pain. These devices also feature the ability to deliver a continuous stimulus lasting as long as the button is held down or until the receiver unit automatically shuts off and resets after approximately 8 to 12 seconds. Alternatively, a stimulus lasting a fraction of a second can be selected for the delivery of precise stimulation and prompting effects similar to that produced by leash checks. These various operational features satisfy the technical requirements for effective

punishment and negative reinforcement, and give the trainer fingertip control over the timing, intensity, and duration of aversive stimulation. In addition to the delivery of a controlled e-stimulus, various tone and vibratory stimuli can be delivered in close pre-event and postevent association with ES, so that conditioned positive and negative reinforcers, punishers, and other signals (e.g., safety signals) can be developed and used to facilitate electronic training objectives. In combination, these various features help to minimize the amount of aversive ES needed to reach training objectives while maximizing a trainer's creative control over the delivery, intensity, and duration of aversive stimulation.

The effective use of ES requires significant skill and understanding of the training process. Ideally, such devices should be used only in the context of supervised training and behavior modification. Once a foundation of reward-based training is in place incorporating positive reinforcement, structured play, and various conventional directive efforts, remote electronic enhancement can be employed to achieve improved control at a distance (Tortora, 1982). Electronic training is also used to establish basic control that is not otherwise efficiently obtained by reward-based techniques alone. Once the training objectives are achieved via electronic procedures, positive reinforcement is used to maintain and generalize the behavior. Combining escape/avoidance training with positive reinforcement appears to optimize conditioning effects. For example, Franchina (1969) found that trained behavior is enhanced by exposing animals to a contingency in which target responses are followed by both shock offset and the presentation of a food reward. In the case of animals where the food reward was omitted but the shock-escape contingency held constant, the performance of animals declined below levels attained by the use of negative reinforcement alone. These findings stress the importance of combining both positive- reinforcement and negative-reinforcement procedures to optimize performance reliability. Despite a significant potential for misuse and abuse, electronic training tools provide significant advantages for skilled users (Table 9.1).

Electronic training is efficacious and warranted in situations where enhanced remote control of a dog is needed or when problem-solving objectives demand accurate, timely,

TABLE 9.1. Advantages of electronic devices for delivering aversive stimulation (ES, electrical stimulation)

ES is the most thoroughly studied aversive used in animal behavior and learning research.
ES at the levels used in dog training is virtually harmless, giving no evidence of lasting pain, tissue damage, or psychological trauma.
ES has many aversive control applications, ranging from escape/avoidance training (negative reinforcement) and suppression (positive punishment) to aversive counterconditioning.
ES intensity can be adjusted from very low and barely perceptible stimulation up to startling and highly aversive levels, thereby accurately matching a dog's specific needs and temperament.
ES duration can be precisely regulated, ranging from a fraction of a second to several seconds long.
ES can be delivered instantaneously at various distances from a dog.
ES can be delivered without the owner being present or being directly associated with the owner as its cause.
ES training appears to depend more on startle and annoyance than pain.
ES training techniques are highly compatible with instrumental training procedures (e.g., clicker training), enhancing performance, reliability, and assisting in problem-solving activities.
ES training techniques facilitate safe and reliable off-leash control and recall training.
ES training aids are relatively easy to use.

and remote aversive stimulation. Although radio-controlled e-collars are inappropriate for use as the initial or primary means for establishing basic obedience control, no comparable techniques or tools currently available can match the efficacy and safety of the e-collar for establishing safe and reliable off-leash control. In any case, humane electronic training procedures employ a minimal level of aversive stimulation to achieve behavioral objectives. Most dogs are highly responsive to ES set at levels that are barely perceptible to human touch. For the vast majority of training objectives, stimulation never exceeds a painless tingling or occasional twitching or pricking level. When properly used, electronic stimulation produces rapid and steady avoidance learning or, when applied at higher levels of stimulation as a punitive stimulus, suppression is often immediate and lasting. If minimizing the intensity, duration, and frequency of aversive stimulation during training is recognized as a significant factor in the definition of humane dog training, the radio-controlled e-collar must then be ranked as one of the most humane dog-training tools currently available.

Although most obedience-training objectives can be adequately achieved using a combination of reward-based methods and directive techniques, such approaches may not be sufficient to achieve effective control over high-spirited dogs under circumstances of increased motivation or distraction. Maintaining control under such circumstances may be especially problematic with adult dogs that have learned to evade the owner or run out of control when let off leash outdoors. Further, some dog owners may simply lack the physical strength and coordination to effectively use a leash and collar, long line, or throw tools. For example, elderly dog owners may be challenged beyond their means when faced with the behavioral excesses of an overly active dog. For such owners, leash and collar or halter restraint may not provide adequate means of control. Furthermore, despite the most conscientious reward-based training efforts, such training may not adequately curb canine appetites and excesses to a point of ensuring safe interaction with a fragile or physically disabled handler. Under such circumstances, electronic training aids may prove extremely useful and beneficial. Properly introduced, surprisingly low levels of ES can cause otherwise inattentive and uncooperative dogs to learn rapidly to comply with owner demands and directives that previously went unheeded. Basic control elements such as sit, down, stay, and come can be quickly enhanced and made more reliable by brief exposure to escape/avoidance training involving LLES. A combined approach incorporating both positive and negative reinforcement optimizes training efforts (see *Behavioral Equilibrium*). Optimization results in a rapid increase in performance reliability and fluency over a wide range of motivational and environmental conditions.

First and foremost, electronic training provides efficient means to enhance attention and impulse control under adverse environmental and motivational conditions requiring close timing of aversive stimulation, especially when a dog is off leash. The e-collar can be effectively used to induce a dog to perform more reliably under challenging situations in which it is most likely to hesitate, refuse, or disobey by engaging in behavior incompatible with training objectives. Obviously, securing a dog's attention provides a powerful means for initiating impulse-control training. In combination with attention training, training efforts that focus on relevant intentional movements that anticipate the loss of impulse control help to facilitate more reliable behavioral control. Establishing control over orienting behavior and intentional movements requires a high degree of precision. If a dog is kept in close proximity on leash or otherwise restricted, various nonaversive tools and techniques may suffice; however, with the dog at some distance away, operating under the influence of natural environments and contingencies of reinforcement, nothing provides the required control and fine-tuning more efficaciously than an e-collar. Most dogs can be trained effectively without electronic enhancement, but in cases in which dogs exhibit dangerous behavior that risks injury to itself or others, intervention with electronic training is definitely a viable and humane alternative to traditional punishment techniques.

As is discussed in the section *Electrical Stimulation and Aggression*, electronic training and enhancement of basic-training modules and routines may play a valuable therapeutic role in counteracting established patterns of inappropriate and reactive behavior occurring under aversive or threatening situations. Highly structured and systematic training using ES may help to enhance a dog's social competence and confidence by teaching it that it can control (avoid or escape) aversive events by means of cooperative behavior, thereby potentially reducing the likelihood of maladaptive aggression or panic responses when confronted with adversity. Of course, using electrical training techniques to control potentially aggressive dogs requires that trainers possess significant knowledge and experience with such dogs and a working understanding of the benefits and hazards of electrical training. Inappropriately painful or poorly timed stimulation may make such problems worse or elicit an aggressive response (Polsky, 2000). Radio-controlled ES has the advantage of minimizing the need for direct manual control of an aggressive dog—a valuable asset in the case of dogs prone to attack when touched or handled.

Behavior-activated Electronic Training

Citronella-spray Collars

Bark-activated citronella collars appear to be effective for controlling certain barking problems (Wells, 2001) but are not necessarily less aversive to dogs than are electronic counterparts. One study comparing the punitive effects of a citronella collar with an electrical device reported that the citronella treatment was more effective than shock in suppressing nuisance barking in dogs (Juarbe-Diaz and Houpt, 1996). The authors found that 89% of the owners using the citronella collar to control excessive barking reported satisfactory results, whereas 44% of owners using an e-collar reported satisfactory results. Unfortunately, the study was limited to nine dogs, and the authors may have been biased with respect to citronella devices (Wells, 2001)—a bias that one of the authors appears to acknowledge in another context (Juarbe-Diaz, 1997). Given the acuity of a dog's olfactory sensibilities, it is not surprising that a potent aerosol odorant sprayed near a dog's nose and mouth would be aversive. What is surprising, however, is that the citronella device outperformed the electronic one—a finding that one should view with some skepticism, at least until a larger controlled study is performed and the findings confirmed. Although the citronella odor may be annoying to dogs, bark-activated spray devices appear to depend primarily on the effects of startle, with the odor of dilute citronella playing a secondary role. Citronella scent delivered without spray does not appear to suppress barking, but the scent may become an inhibitory stimulus as the result of aversive conditioning.

Recent studies seem to indicate that the citronella scent may not play a significant role in the inhibition of barking. Beaudet (2001) found that both scented and unscented spray collars worked about equally well to suppress barking, with 85% of owners reporting satisfaction with the citronella-scented stimulus versus 80% satisfaction with the unscented stimulus (N = 33). Similarly, Moffat and Landsberg (2001) have shown that unscented spray collars can produce a significant reduction in barking, comparable to that produced by citronella-scented collars (78% improved or controlled with citronella collars versus 57% improved or controlled with unscented collars; N = 36). The hiss produced by spray collars may be preferentially processed by the amygdala, eliciting unconditioned fear and startle. In addition, the amygdala is a primary destination of olfactory inputs, preparing and enabling a conditioned aversive association between a novel odor and startle to develop rapidly.

Bark-activated citronella collars produce approximately 15 to 25 gradually diminishing spray bursts until the spray reservoir is depleted—an operational limitation that habitual barkers may learn to exploit. Given the tendency of dogs to habituate to odors and noises, it is reasonable to assume that repeated bursts of citronella spray may progressively produce less of an effect on dogs. The effect of habituation may be significantly

more troublesome in situations where a dog is left alone and exposed to a high level of bark-evoking stimulation. Along these lines, Wells (2001) has reported that a significant amount of habituation does occur in response to repeated spray stimulation. Her study indicates that, after producing a pronounced initial reduction in barking, dogs gradually habituated to the spray event—an effect that continued during the 3-week treatment program. Interestingly, she found that intermittent treatment (dogs wearing the collar every other day) produced a more lasting suppressive effect over nuisance barking than did the continuous treatment program. Both the continuous and intermittent treatment groups were exposed to bark-provoking stimulation for 30 minutes a day. In addition to a rapidly depleted spray reservoir, a problematic feature of citronella devices is microphone activation. Ambient noises, including the barking of nearby dogs, may activate the devise, thus exposing the dog to inappropriate and noncontingent punishment—apparently a fairly common complaint (Juarbe-Diaz and Houpt, 1996). Also, under outdoor conditions, the spray may be affected by wind and other influences, perhaps making it less effective for such use. Finally, citronella spray as an olfactory deterrent may be inappropriate for dogs used for tracking, search and rescue, or other activities requiring sharp olfactory abilities, since repeated exposure may potentially blunt olfactory acuity. A major advantage of the citronella-type collar is that it does not depend on prong-to-skin contact to deliver stimulation, thereby avoiding unnecessary irritation and discomfort to dogs with sensitive skin.

Electrical Bark Collars

The sustained noise generated by multiple dogs barking in kennel situations commonly exceeds 100 decibels (dB) and often reaches levels as high 125 dB—a range that can damage both human and canine hearing (Sales et al., 1997). The noise associated with excessive barking can hurt ears, and it can harm neighbor relations and lead to legal consequences involving citations, fines, and eviction notices. These pressures can cause a dog owner to take extreme measures, such as relinquishing the dog, resorting to severe punishment, or employing inappropriate restraint procedures. Most dogs can rapidly learn to inhibit excessive barking after the contingent delivery of a brief e-stimulus presented in close association with the barking action each time that a dogs barks (Arguello, 1986). Bark-activated collars can be adjusted to match a dog's temperament and specific behavioral needs. Some devices provide a brief obligatory intertrial interval, during which barking or yelping does not activate the collar. One device also keeps count of the stimulations delivered, providing a useful source of data. A voice-activated recorder can also be used to keep track of barking activity. Unfortunately, not all bark-activated collars perform reliably, and only the highest-quality collars should be selected for use in the context of behavior therapy. Although some collars are designed to be relatively insensitive to nearby loud noises (e.g., other dogs barking) and impact vibrations, certain cheap collars sold in pet stores are activated by being bumped or when scraped when the dog lies down or moves about. This defect can be especially problematic and harmful with dogs confined to crates. Some of these problems can be prevented by encasing the collar in a thin protective foam sheath or by covering it with a bandana worn by the dog. Proper control of excessive barking depends on an accurate and detailed evaluation of underlying causes. In addition to performing behavioral assessment, the trainer should explore minimally aversive behavior-control techniques and reward-based strategies before opting to use bark-activated ES (see *Barking* in Chapter 5). The introduction of a bark collar should not be decided casually and never without giving serious thought to potential side effects that might result from bark-activated ES. Certain behavior problems that present with excessive barking, such as separation distress and panic (see *Electrical Stimulation and Excessive Barking*), may be exacerbated by aversive electrical procedures.

Ideally, whenever behavior-activated electronic devices are used in the context of behavior therapy, preliminary radio-controlled training incorporating LLES should be per-

formed with the goal of training the dog to *perceive* that it has control over the occurrence of the ES. Preliminary training should begin with the enhancement and refinement of various basic modules and routines, especially attention and orienting responses, sit, stay, back and wait, slack-leash walking, and recall training. In addition, barking behavior should be brought under stimulus control, whereby the dog learns to bark on command and to stop barking on command. Stimulus control is established via reward-based discrimination learning. Training a dog to bark on command appears to increase its ability to autoregulate bark-related arousal and impulses without becoming overly inhibited. Once basic stimulus control over the bark response is established, a vibratory stimulus is used in conjunction with a stop-bark command, followed by LLES alone or LLES embedded in a brief continuous vibratory stimulus overlapping undesirable or off-cue barking behavior. As the barking activity ceases, the stimulation should also immediately stop, followed by social and appetitive rewards. On every occasion in which the dog barks inappropriately, the e-stimulus is delivered along a staggered intensity gradient until a level is reached that instantly suppresses the bark response and results in sustained bark avoidance, thereby approximating the level of stimulation needed by the bark-activated collar to maintain the bark inhibition. The goal is to establish a level of ES sufficient to inhibit barking but without causing the dog undue discomfort or distress. Before transitioning to a bark-activated collar, transfer training and tests are performed with the dog left in various bark-stimulating situations while wearing a radio-controlled collar. Many potential problems are avoided by slowly introducing ES via radio-controlled training before advancing to the bark-activated stimulator.

Electronic Containment Systems

The most common use of behavior-activated electronic devices involves ES to train dogs to stay within the confines of a property boundary. The exact number of electronic boundary systems in current use is not known, but one large company alone has reported installing some 500,000 units from 1982 to 1997 (Polsky, 2000). Some electronic boundary systems use a relatively strong e-stimulus that may cause some dogs to experience significant pain, fear, and distress. Dogs inappropriately exposed to boundary ES may show intense fear and avoidance of the yard, especially when a young dog has been denied access to the yard for play and training prior to the event. Prior safe exposure to the yard appears to promote latent inhibition and conditioned associations incompatible with fear (comfort and safety). The first experience of some dogs to being walked on leash by a stranger is one in which they are pulled into the boundary field and forced to experience intense ES by a containment-system salesperson or installer. As a result of such exposure, such dogs may show strong generalized anxiety or reactive behavior whenever they are put on leash, along with a lasting wariness or autoprotective behavior toward strangers encountered near the boundary, especially those that might reach for or attempt to restrain the dog. In cases where stimulation occurs while the dog is in the presence of two persons, one familiar and one unfamiliar, the event shows an associative affinity for the unfamiliar person, even though the dog might actually be in a slightly closer proximity to the more familiar person at the moment of stimulation. The resulting social fear response toward the unfamiliar person may be highly durable and resistant to extinction and counterconditioning efforts. Adventitious ES occurring in association with safe activities, such as play or tagging along with children, can exert a profound loss of trust and security that may compromise a dog's ability to feel safe or to relax when engaged in those activities. Dogs exhibiting problematic temperament traits (e.g., excessive fearfulness or aggressiveness) should not (or only cautiously) be contained electronically, because in some dogs ES may elicit global panic reactions or an increased risk of directing aggressive behavior toward persons or animals entering the property. However, even dogs without an established history of aggressive behavior or fearfulness, *may*, under certain circumstances, become aggressively

aroused when electrically stimulated (Polsky, 1998 and 2000). Obviously, particular caution should be used when employing such devices indoors, where there exists an increased likelihood of stimulation in close proximity to people. To reduce the stress associated with electronic containment, the fenced area should be large enough to allow the dog to move about freely without fear of triggering ES.

Preliminary enhancement of basic modules and routines with a radio-controlled collar is useful and avoids many of the present pitfalls associated with boundary training. Such training instills positive prediction-control expectancies and establishing operations conducive to a competent escape-to-safety pattern of proactive adjustment to ES. After a basic introduction to attention, stay, back and wait, halt-stay, and recall training, boundary training is introduced using these basic modules, as needed. Eventually, the boundary collar can be fastened in combination with the radio-controlled collar in order to establish appropriate conditioned escape/avoidance responses, beginning with LLES and then gradually introducing additional distractions and increasing intensity as required to maintain and enhance the avoidance response. The idea is to train the dog to perceive the LLES as a controllable event (e-stimulus) or cue (e-signal) predictive of safety, provided that it turn or back away in response to the warning signal. Initially, the dog is kept on a long line so that any hesitation or contrary response can be immediately countered with appropriate prompting or redirection. As training progresses, failure to turn or back or turn away is followed by an appropriately intense event to establish reliable deterrence. Throughout the process, the trainer should provide constructive support and offer the dog a haven of safety and play as it learns to respond to boundary warning tone as an avoidance signal. In addition to learning that the boundary ES is controllable, the dog must be given sufficient exposure to play and rewarding activities in the yard to make it a viable escape-to-safety destination. In addition to learning the boundary rule, various important secondary inhibitory lessons (e.g., all-stop, stop-change, and go/no go) and enhanced impulse control can be acquired in the context of boundary training, thereby further maximizing the potential add-on benefits that might be obtained through the process.

Puppies at 16 to 20 weeks that are destined to undergo inhibitory boundary conditioning probably stand to benefit most from the gradual introduction of controllable ES via preliminary radio-controlled training using LLES. During preliminary training, the trainer can get an accurate idea of the amount of ES needed to establish reliable behavior-activated boundary control. In addition to the benefits of a radio-controlled introductory phase, emotional distress associated with boundary training can be reduced significantly by incrementally introducing the deterrent level of ES through steps of appropriate exposure and training. If the containment system lacks sufficient adjustability to match the output level of the e-collar to the particular needs of the dog, a set of insulated resistors or an adjustable potentiometer might be used as a voltage divider to achieve the desired adjustability. Any modifications of this nature to an e-collar device should be performed under the advisement of an electrical technician and only after consulting with the manufacturer for any potential incompatibilities. Finally, unless extraordinary circumstances warrant otherwise, electronic boundary training in earnest should not be commenced until the puppy is 6 months of age.

Although electronic containment systems are effective when properly installed and maintained, whenever possible a physical fence is preferable to an electronic one for confining dogs. In addition to keeping the dog in the yard, a physical fence keeps other dogs and people out. With dogs that jump over or dig under fencing, an electronic fence can be installed to discourage such escape behavior. To be effective, e-collars must be snugly fitted to ensure that both electrodes make contact with the dog's skin. This operational feature can be a source of significant discomfort, especially if the collar is kept on a dog for long periods. After prolonged and continuous wear, the skin may become irritated or experience significant tissue damage

(contact necrosis) (Polsky, 1994). Another problem becomes evident only after a dog escapes from the yard and attempts to get back inside, whereupon it is stimulated and caused to flee the property. In neighborhoods where many of the same electronic containment systems are installed, the roaming dog may be repeatedly stimulated, perhaps causing it to seek safety in the worst possible place: the middle of the road! Hopefully, manufacturers will design systems in the future that allow the dog to reenter the yard and devise safeguards against extraneous stimulation by other containment systems. In addition, a telephone paging system that automatically calls and warns the owner, or triggers an alarm within the house, whenever the dog escapes the yard would be a valuable enhancement of such systems. Given the risks of escaping from the yard and the potential danger posed by other dogs freely entering the property, containment systems should include video surveillance for observing the goings-on in the yard. The cable feed could be put into the ground at the same time the containment system is installed. There is an obvious marketing angle here that might be of interest to the containment-system distributors, whereby the combination of containment and surveillance arguably provides a combination of enhanced home security and safety benefits. Such video capability would also offer an enhanced means for keeping a closer eye on children playing in the yard. A miniaturized rf-video camera and microphone built into the collar itself would also be of immense utility. Finally, video surveillance is an extremely useful means for studying dog behavior as well as addressing a variety of common outdoor behavior problems with the aid of radio-controlled spray or ES. Inexpensive two-way radios often have a variety of tones and voice-transmission capabilities that can provide a flexible communication interface when the receiver is placed at a fixed location such as near a door or when it is attached to the dog's collar.

Dogs that repeatedly run through electronic boundaries are a potential threat to themselves and to the public safety. There are several causes associated with the failure of such containment systems:

- Damage to the boundary wire
- Inoperative transmitter or receiving collar
- Worn-out batteries
- Improper fitting of the collar
- Improper training

Of this group, the leading cause of failure appears to stem from improper training. In one case, an owner deliberately encouraged a dog to run across the boundary field by calling and cajoling it from the other side, with the dog held on leash by another family member. The dog eventually pulled into the field and reached the owner, whereupon it was pulled back through the field and into the yard as punishment. The dog subsequently exhibited pronounced submission behavior (crawling on her belly, rolling over, and hunching up tightly) when approached by anyone coming into the yard. The dog also showed increased submissive-type urination when greeting visitors at the door. In another case, a dog learned to run through the field after children were instructed to run back and forth across the boundary, with the goal of proofing the inhibition. Other dogs inappropriately exposed to boundary training while off leash have succeeded in escaping from a yard after taking several e-stimulations while running wildly around the yard in a panic, until they finally dash headlong through the field. Many have learned to run through the field while pursuing another dog or while chasing wildlife off the property. One dog was strongly tempted by the lure of livestock kept by a neighbor. The dog would periodically break through the boundary to harass the animals, after which he would return home and wait for the owner to turn off the system so that he could get back inside the yard. In some cases, dogs sharing a residence may follow one another through the boundary. In one instance, a male and female pair occasionally escaped from the yard to jolly about in the neighborhood. On one of these occasions, the family was devastated when they learned that both the dogs had been killed while attempting to cross a four-lane highway near the home. Other sorts of problems peri-

odically involve more idiosyncratic behaviors and causes. In one of these exceptional cases, a dog developed an odd habit resembling learned helplessness, whereby he would stand in the stimulation field shaking stoically and unable to back away or to move forward through the boundary without the help of a family member who had to physically pull the dog back out of the field. This particular dog apparently experienced the e-stimulus around its neck as an inescapable event. Another dog learned to habitually run through the boundary after she had been equipped with a bark-activated collar. Prior to this change, the dog had never broken through the boundary and had learned to closely hug the warning field, from where it persistently barked at other dogs and passersby. Once equipped with the bark collar, the dog began to run out of the yard whenever the collar was activated, perhaps confusing the bark-activated ES as an uncontrollable stimulus coming from the containment system. After a while, the barking behavior stopped, but the dog continued to run through the boundary, even though she received a strong e-stimulus on each occasion.

Dogs that habitually run through the warning and stimulation field appear to have learned an escape/avoidance strategy that is incompatible with containment. Since the act of running over the line ultimately terminates stimulation, the sequence undergoes significant reinforcement every time the dog succeeds. The situation is compounded if the dog attempts to return to the safety of the yard, since the collar is activated a second time. Instead of backing away from the field in response to the warning signal, these dogs acquire an opposite habit whereby they attempt to charge through the field as quickly as possible. In cases where an intractable escape habit has been well established and retraining has failed to improve a dog's response, a special procedure may be useful. A 30- to 50-foot nylon rope is secured to some stationary object and attached to the dog. The stationary line should be set up near locations where the dog has habitually escaped. The rope should be arranged to give the dog enough room to activate the warning field, but prevent the dog from going beyond it. During such training, a radio-controlled collar is used in combination with the containment collar to enable the trainer to apply sufficient ES to deter inappropriate escape. At such times, the stationary line can be used to pull the dog out of the warning field, if necessary. As a result of the foregoing procedure, the inappropriate escape response is thwarted, making retreat into the safety of the yard the only escape option available. Once it is evident that the dog has learned the appropriate avoidance response, various proofing procedures should be performed to further reduce any risk that the dog will charge through the boundary in the future. Dogs that continue to run off the property despite such additional training and deterrence efforts are not good candidates for such confinement.

The use of electronic containment systems for indoor behavior control and restriction should be seriously reexamined with regard to behavioral and social considerations. Although one practitioner has suggested that an indoor ES delivered by such systems can be useful as a means to "protect children from pets and help orchestrate space sharing by pets" (Overall, 1997:288), electrical boundary training indoors can produce significant fear and consequently risks generating reactive behavior in association with approach-avoidance conflict and anxiety, especially around locations where the collar has been activated in the past while the dog was approaching, following, or playing with a family member or another companion animal sharing the household. Defining a property boundary by means of ES seems to be of a radically different nature than training a dog to avoid following family members within the context of the home. Further, given the possibility that boundary-activated devices may elicit aggression in some emotionally reactive and predisposed dogs (Polsky, 2000), the use of indoor electrical barriers to control the movements of dogs likely to show an escalation of aggression in response to ES should be avoided. Indoor electronic containment might be considered in some situations involving dogs that exhibit persistent house-training problems or destructive behaviors, but only after conventional training efforts have been attempted and

failed to train the dog to stay out of forbidden parts of the house, and then only when gates or doors are not practical as the primary means of confinement. Indoor electronic containment may be useful for the control of some problems involving cat chasing and harassment; however, with highly motivated or aggressive dogs, electronic fencing does not provide a fail-safe barrier and should not be used to contain dogs with a history of attacking cats. Finally, properly performed electrical training minimizes associative linkages between the aversive event and the trainer, while encouraging the dog to seek comfort and safety from the owner in association with postevent relief, relaxation, and various rewards.

Caution: The quality of radio-controlled training collars and containment systems varies greatly, requiring that prospective users research the available products to ensure that the system selected is reliable, effective, and humane. Malfunctions resulting in the delivery of uncontrolled ES are uncommon; nonetheless, and despite numerous improvements over the years, no electronic device is entirely fail-safe. Further, not all radio-controlled and behavior-activated electronic training devices provide the same level of safe operation and adjustable stimulation. The quality and "feel" of ES vary among the devices available, with the best products producing a pulse that minimizes pricking and stinging effects. Professional use of such products demands careful attention to the functional fitness and humaneness of the electronic training aids selected. A number of manufacturers have emerged as leaders in the field of electronic training, and professional trainer/behaviorists are well advised to use only those products that offer the highest standards of operational reliability and incorporate low-level stimulation. Selecting from systems that feature rechargeable batteries in both the transmitter and the receiver unit—ultimately a wise selection criterion given the cost of replacement batteries for such devices—significantly narrows the field of possible collars from which to choose. Electronic training devices that produce excessively painful or traumatic shock should be avoided, as should techniques calling for such stimulation.

Basic Training and Enhancement

Electronic training is most effective when it is used to enhance basic modules and routines previously shaped by means of conventional reward-based training. Ideally, the trainer performs introductory electrical training and gradually transfers control of the transmitter to the owner as a basic understanding of the process developed. Most dogs show little or no emotional reactivity or signs of distress to LLES. Although they may find the stimulus annoying, they are not usually frightened by it. Initially, some dogs may exhibit very minor and transient signs of alarm in response to LLES—signs that rapidly habituate and give way to increasing confidence and relaxation as they learn to control the electrical event. Although the vast majority of dogs appear to be highly receptive and responsive to electronic training, some may exhibit an adverse response to ES. Dogs that show signs of reactive aggression, fear, persistent anxiety, insecurity, or depression in response to ES are not good candidates for such training. Also, dogs exposed previously to electronic containment training may exhibit signs of hypersensitization and problematic escape and avoidance behavior in response to LLES. Aside from brief phantom biting and mouthing movements in the direction of the collar, the author has never observed a dog react aggressively toward a person or another dog in response to radio-controlled ES. However, reactive aggression has been reported in association with electronic containment systems (Polsky, 2000). Also, Beaudet (2001) mentions a Jack Russell terrier that appeared to become "mad" when sprayed by a bark-activated citronella collar, causing it to bark more when corrected by the device. Although reactive aggression appears to be relatively rare, such undesirable behavior should be considered a risk in dogs showing unstable temperaments or a standing history of aggressive behavior, where ES is delivered while the dog is in close proximity

(particularly while making physical contact) with a person or another dog.

For dogs showing insecure behavior in response to LLES, electronic training can be introduced in combination with vibrotactile stimulation and target-arc training. A vibration stimulus is paired with an established target-arc stimulus in order to facilitate a safe preemptive bias toward the stimulus while habituating inappropriate aversive responses to the stimulation. The lowest level of ES is gradually introduced by embedding it within the vibration stimulus, thereby amplifying the orienting response, which is followed by a click and a flick of the right hand. Such dogs are given basic radio-controlled training that shadows previous reward-based training, especially orienting and recall modules and routines, until the dog shows a highly competent and confident response to conditioned signals and LLES. Successful responses are bridged and rewarded with food and other rewards presented on a schedule conducive to positive prediction error (surprise). Signs of fearful behavior are interrupted at the earliest point by evoking a target-arc response, followed by an orienting "Good!" (or a click), hand flick, and reward. The evocation of strong escape/avoidance behavior should be avoided, but such behavior that does occur should be blocked with a leash or long line worn by the dog at all times during the initial stages of training. At such times, the dog is turned around (with the long line if necessary), whereupon "Relax" is spoken just as the e-stimulus is turned off. The most common cause of excessive reactivity is sensitization resulting from previous traumatic exposure to electronic training or exposure to sensitizing aversive events (e.g., bark-activated and boundary-activated collars). Electronic training procedures using HLES should be performed under the supervision of experienced trainers who are knowledgeable concerning the benefits and potential risks associated with safety training.

Attention Training

Most problems necessitating electronic intervention stem from attention and impulse-control deficiencies. Electronic enhancement of attention and orienting behavior is introduced in the context of moderate environmental distraction with the dog on a leash or a long line. A continuous low-level pulse is delivered that is sufficient to get the distracted dog's attention but without evoking startle or evidence of distress. The attention-controlling effect of ES is attained in many dogs at very low levels of stimulation, often imperceptible to human touch; however, since dogs differ with respect to their sensitivity to ES, some may require a significantly stronger level to motivate an attentional response, especially when acting under the influence of strong distractions. Whatever the case, it is critical that ES levels be precisely calculated and controlled to match an individual dog's specific needs, circumstances at the time of stimulation, and the training objectives. Consequently, only electronic training collars that deliver a finely adjustable and reliable e-stimulus, ideally in combination with vibrotactile capability, should be used for such training purposes. As the e-stimulus is delivered, a smooching, squeaker, or whistle sound is made to attract the dog's attention. If the dog fails to orient toward the trainer as the ES continues, it is prompted with the long line to turn its head. As the dog turns, conditioned negative reinforcement (S^{r-}) (voice, click, or tone) is timed and presented to occur just before the e-stimulus is discontinued (Figure 9.1). The S^{r-} identifies the specific behavior that turns off the e-stimulus (escape phase), and, when presented in association with the controlling discriminative stimulus, the S^{r-} signifies that the response successfully avoided the aversive event. In the latter case, the S^{r-} not only serves to reinforce the avoidance response, but its presentation predicts safety from aversive stimulation. Several layers of reward are associated with the successful control of aversive motivational incentives.

Since the termination or reduction of aversive stimulation is perceived as a rewarding event, actions and stimuli paired with the discontinuation of ES gradually acquire reward value of a positive nature—that is, the dog will work to produce them—helping to explain the power of conditioned negative

reinforcement to support avoidance learning. In addition, successful escape promotes rewarding associations with social and contextual stimuli paired with successful escape-to-safety behavior, and such stimuli (conditioned safety signals) acquire potent motivational significance for the dog (e.g., praise). As opposed to escape-from-fear associations, associations acquired during escape to safety may possess significant reward value that can be used in a variety of training situations (e.g., praise supporting the maintenance of obedience to command) and behavior-therapy contexts, but may be especially useful in the context of facilitating social attachment and confidence. The most significant source of reward for dogs that is obtained in the context of electronic training is mediated by the successful control of the aversive event. Perceiving that the e-stimulus is controllable by purposive efforts is not only a profound source of reward mediated by enhanced comfort and safety, but such learning contributes to the integration of an adaptive coping style via the organization of control-expectancy modules (prediction-control expectancies, calibrated establishing operations, and specific actions or sequences). When an aversive event is successfully terminated, reduced, postponed, or avoided in accordance with a rule or set of prediction-control expectancies, the dog acquires an increased sense of confidence or power over the threatening event. Repeated successful control over aversive events promotes competence, confidence, and a high-power control style conducive to elation, contentment, and well-being.

With the dog orienting toward the trainer, it is induced to come with affectionate encouragement and rewarded in ways conducive to promoting a sense of safety. If the dog attempts to turn away from the trainer instead, the LLES is applied and sustained until the dog turns back again. Once more, as the dog turns its head, S^{r-} (voice, click, or tone) is delivered just before stimulation is discontinued. After brief intertrial delays, similar trials are repeated until the dog rapidly turns its attention toward the trainer as soon as the e-stimulus is delivered. This escape phase of training is followed by an avoidance phase in which the dog's name is spoken just before the smooching or squeaker sound is made to intensify the orienting response. If the dog fails to orient, the e-stimulus is applied at a slightly higher level and immediately removed just as the dog turns toward the trainer. If the dog responds to its name alone, the reward bridge ("Good') is delivered just as it turns toward the trainer.

Recall Enhancement

Recall enhancement is easily integrated with attention-control training by saying "Come" just as the dog steps in the direction of the trainer. On every occasion in which the dog successfully comes, it should be enthusiastically praised, rewarded, and released following the various procedures described in Chapter 1. Compelling a dog to come via ES is usually unnecessary and should be avoided unless special circumstances warrant such training. In some cases, prompting (repeated momentary pulsing) with LLES may be necessary to compel a highly resistant dog to come; however, most dogs learn to come reliably with positive reinforcement alone, especially after electronic training is used to enhance attention and impulse control. During the early phases of recall and attention-control training, there is a strong tendency for inexperienced trainers to point or poke the handheld transmitter at the dog as they deliver stimulation. This is not necessary and may actually cause the dog to become overly aware of the trainer as the source of stimulation and adversely affect its response to electronic training. The dog does not need to know where the stimulation is originating in order for it to be effective. As a general rule, it is best not to move or show the dog the transmitter. This precaution helps to minimize the risk that the dog might associate the movement of the hand with the e-stimulus. This is especially critical in situations where the trainer is in full view of the dog. Stimulation should prompt the dog to seek security by making contact or by cooperating with the trainer's instruction. Throughout the electronic training process, the trainer's role is that of constructive guide and source of support and security. As a

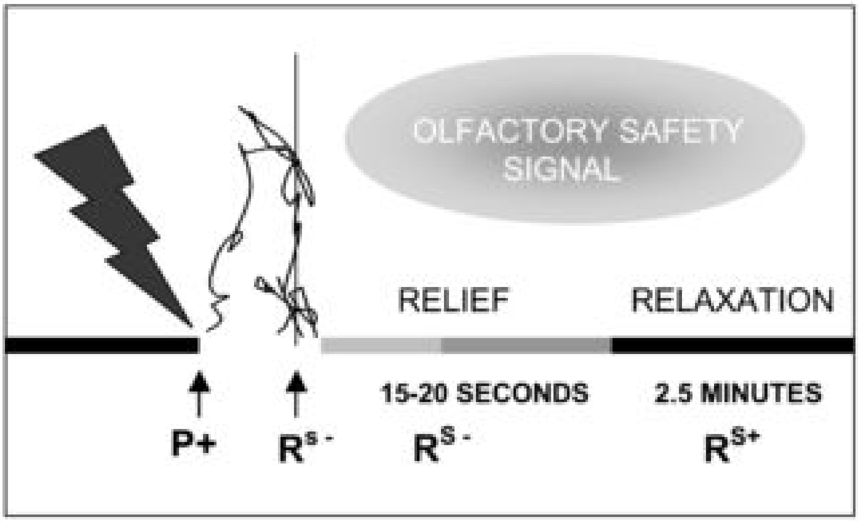

FIG. 9.1 The conditioned negative reinforcer R^{s-} immediately precedes the termination of the e-stimulus (P+), followed by opponent relief and relaxation (safety), providing both positive (R^{S+}) and negative (R^{S-})reinforcing effects. An olfactory stimulus presented to overlap with the postevent opponent relief and relaxation effects may gradually acquire conditioned associations capable of producing feelings of safety.

result, properly employed electrical training may significantly enhance a dog's connection and willingness to cooperate with the trainer.

Enhancing the Freeze Response

Training a dog to freeze on command dramatically enhances impulse control and recall reliability. The following procedure assumes that the dog has received long-line training as discussed in Chapter 1 and has been exposed to preliminary recall enhancement with LLES. With the dog on a long line and bolting toward some distraction, the command "Stay" is spoken in an abrupt and assertive tone just in advance of a brief pulse of high-end MLES. As the dog stops, the trainer quickly moves to the dog's position or calls it to "Come," whereupon the response is appropriately reinforced with sustained petting and food. An intertrial period of 2 1/2 to 3 minutes is provided to give the dog time to benefit fully from the ensuing postaversive relief and relaxation response. During this relief/relaxation period, various reward-based training and play activities are used to enhance the dog's confidence in the trainer as a source of safety and nurturance. The foregoing procedure is repeated under increasingly difficult and distracting circumstances until the dog learns reliably to freeze in response to the "Stay" command without ES. With each level of mastery, the dog is trained to freeze, stay, and to come when called. Recall is highly prepared under such circumstances, with the dog seeking the safety of close contact with the trainer. After the dog comes to a halt, its name is called. If the dog turns, a reward bridge is presented (e.g., "Good" or click), and the dog is called to "Come." As the dog reaches the trainer, it is appropriately rewarded with appetitive-positive and social-positive reinforcement. If the dog fails to orient (as may occur under the influence of a strongly distracting stimulus), a whistle or squeaker is presented and, if necessary, LLES is delivered together with directive prompting with the a long line. If the dog begins to come, but then turns away toward the distraction, a stronger level of LLES is delivered to secure control and turn the dog's attention away from the distraction. In cases involving dogs with particularly strong motivational interests in some activity or object in the

environment, higher levels of aversive ES may be needed to counteract the attraction. In general, establishing strong impulse control by conditioning a reliable freeze response is a necessary preliminary to obtaining a consistent and reliable recall sequence. After exposure to the stronger e-stimulus used in freeze training, a dog's response to LLES may undergo sensitization, perhaps allowing the trainer to use even lower levels of ES in the future.

Wait and Back

A useful way to enhance impulse control is to apply brief low-level stimulation during the wait and back exercises at the door when leaving the house for a walk. Preliminary training of the wait exercise teaches the dog to respond to the opening of the door by backing away ("Back") and waiting ("Wait") to be released ("Okay"). If the dog lunges ahead before being released, LLES is applied and repeatedly pulsed until the dog backs away from the doorway. The dog quickly learns that it can control stimulation and escape or avoid it by backing away or waiting in response to the door opening or by responding to the vocal signals "Back" and "Wait." Training a dog to wait and to back away from the door is a useful preliminary to enhancing slack-leash and controlled-walking behavior.

Walking on a Slack Leash

Excessive pulling on leash is a common complaint of dog owners. Although pulling can be controlled with traditional methods or halter restraint, such methods for some owners may be impractical or unsuccessful. Conventional halter training is particularly problematic because, when the halter is removed and the dog walked on a flat or slip collar, the pulling behavior may immediately recover despite conscientious positive reinforcement of more acceptable walking behavior while on the halter. Dogs exhibiting persistent habits of lunging or bolting at people, vehicles, or other animals show a pronounced and lasting benefit from even a very brief exposure to electronic training while on leash. The simplest approach is to directly link the presentation of low stimulation at the earliest moment in the pulling sequence and discontinue stimulation at the instant the dog backs off the leash. Surprisingly, most dogs with only modest preliminary training can learn not to pull, requiring only a few low-level stimulations (barely perceptible or imperceptible to human touch). Another method that is highly compatible with slack-leash techniques (see Chapter 1) is to pair momentary stimulation at a higher level with the spring release of slack or just after saying "Easy." An alternative method involves turning away from the pulling dog and applying stimulation just as the leash slack is dropped. By responding in a timely way to these cues, the dog can avoid ES. Once the dog is walking without pulling, appropriate rewards are used to strengthen more focused slack-lease walking, including periodic quick-sit/stay and instant-down/stay exercises.

Enhancing Emergency Exercises: Quick-sit and Instant-down

In the context of problem solving, electronic training is sometimes used to enhance emergency exercises that a dog has already learned (e.g., quick-sit, instant-down, and stay) through positive-reinforcement procedures. Also, in some situations, it may be necessary to improve the speed or reliability of the quick-sit or instant-down, especially when a high degree of impulse control is needed to maintain control in the presence of disruptive environmental distractions or adverse motivational arousal. Using ES to enhance behavioral control assumes as a starting point that the dog possesses a working understanding of the response being strengthened. For example, in the case of the quick-sit, the dog should demonstrate a viable sit response acquired through positive reinforcement and directive training. Again, the basic procedure is carried out with the e-collar set at the lowest level needed to evoke an orienting response and mild annoyance but without causing evidence of startle or discomfort. During the escape phase, ES is presented just before delivery of hand and vocal signals,

which provide the dog with previously acquired information that it can use to escape, that is, control the e-stimulus. Just as the dog begins to sit, the S^{r-} is presented and LLES is immediately discontinued, followed by vocal encouragement and the delivery of various other rewards as the dog completes the action. This procedure is repeated until the dog responds without hesitation and rapidly sits, indicating that it has learned that sitting turns off ES. If the dog has trouble sitting in the presence of ES, the response is induced by appropriate leash prompting or physical manipulation. The avoidance phase is a critical step in which the dog learns that hand and vocal signals can be used to avoid turning on ES in the first place, while setting the occasion for the subsequent delivery of positive reinforcement. During the avoidance phase, the dog's name is spoken to obtain its attention just before the command "Sit" is given in a normal tone followed by the hand signal—a delayed prompt. As the dog sits, appropriate positive reinforcement is delivered; however, if the dog fails to sit, the e-stimulus is applied together with leash prompting and physical manipulation sufficient to induce the dog to sit. If the dog successfully avoids the e-stimulus by sitting in response to the vocal and hand signals alone, the reward bridge ("Good" or click) is presented, followed by positive reinforcement. At the conclusion of each exercise or sequence of exercises, the dog is released with an "Okay" and hand clap.

In addition to strengthening the sit response with negative reinforcement, electrical training can be effectively used to enhance sit-stay reliability. This is a significant shift in emphasis. Instead of strengthening an active response through escape-to-safety training, the goal is to inhibit some action, improve impulse control, and increase the duration of the selected response. The stay exercise is carried out at both the sit-front position and the starting position at the trainer's side, as well as practiced under various naturalistic situations. Electrical stimulation should be delivered together with the command "Stay" at the earliest sign of movement indicating an intention to break the sit-stay position. If necessary, the dog is prompted by leash or physically guided back into the sit position. An important aspect of effective stay training is to emphasize the duration of the response and the release. In fact, in an important sense, stay behavior is most effectively trained by conceiving it as a antecedent waiting period or contingency in anticipation of a response leading to reward. As such, the release signal "Okay" or the opportunity to perform some other response is integrated with the stay behavior. The release from the stay contingency is explicitly trained with reward, just as any other control module. In basic training, control modules (e.g., sit, down, and stand) are treated as default stay exercises; that is, the dog should learn to remain in the position until it is explicitly released with an "Okay" or another command. Gradually, the dog is exposed to progressively more distracting and difficult situations until the quick-sit and stay response is reliable and steady.

Training dogs to drop instantly on command and to stay there is a very useful exercise for highly active, impulsive, and otherwise difficult-to-control dogs. Although the vast majority of dogs can learn to perform the necessary sequence of behaviors without the use of electronic techniques, some highly intrusive, impulsive, and oppositional dogs may resist conventional training efforts. Such dogs often rapidly benefit from electronic enhancement training of the emergency instant-down and stay response. The instant-down is particularly useful for owner's who lack sufficient physical strength or motor ability to otherwise control such dogs. Preliminary training should include intensive reward-based conditioning and shaping efforts and conventional inhibitory training. In advance of electronic enhancement, the dog should exhibit a well-developed understanding of the instant-down and down-stay behavior. Electrical enhancement of the down response is carried out with the dog in both the sit and the stand positions, with the trainer stepping on a slack leash as LLES is delivered, followed by the appropriate vocal and hand signal. If the dog fails to lie down, momentary pulsing of LLES together with appropriate leash prompting or physical assistance should be applied. Once the dog learns to escape the e-

stimulus by quickly lying down, the vocal and hand prompts are given before stimulation. If the dog responds appropriately, the reward bridge is presented at the moment in which the dog begins to lie down, followed by petting, food, and other rewards as the response is completed. Evidence of strong resistance to lying down in the presence of ES usually indicates that additional preliminary reward-based training is needed. The instant-down and stay exercise is practiced in a way similar to the procedure described for the quick-sit and stay. If the dog attempts to get up, ES, coupled with necessary leash prompting, is delivered at the earliest signs of movement and continued until the dog lies back down, whereupon ES is immediately discontinued and followed by appropriate bridging and positive reinforcement. At the conclusion of the instant-down and stay exercise, the dog is released with "Okay" and a hand clap. As with the quick-sit and stay, the instant-down and stay is practiced under varying conditions, lengths of time, distances, and distractions, thereby improving its usefulness and reliability for emergency control purposes.

Behavioral Equilibrium

Any highly motivational training technique may produce behavioral imbalances. As a result, certain classes of highly reinforced behavior may gradually dominate a dog's repertoire to such an extent that the expression of other behavior may be significantly impeded or blocked. For example, in reward-based training, a dog may tend to stay excessively close to its trainer in an effort to maximize its chances of getting food, gradually making it more difficult to shape exercises that either require it to move away from the trainer or to stay away at some distance. Other reinforcement-related imbalances may take the form of anticipatory behavior. For example, dogs that have been repeatedly called after a brief sit-stay may learn to anticipate the recall signal and come without waiting as required. In this case, the recall response is stronger than the stay response, reflecting an imbalance of readiness to perform the one response at the expense of the other. Simply returning to the dog occasionally and rewarding it for staying can help to offset the anticipatory imbalance and restore equilibrium (see Tortora, 1983).

Electronic devices are frequently used to discourage undesirable behavior via punishment. As a result, the dog gradually learns to regard the e-stimulus as an inhibitory signal, causing it to freeze when the collar is activated. This would be a highly undesirable outcome if one wished to negatively reinforce a behavior requiring the dog to move toward or away from the trainer. Ideally, the dog should learn to increasingly respond to ES as an e-signal anticipating safety and reward rather than an aversive event compelling escape. Other problems may emerge if the device is used exclusively to reinforce a fixed sequence of exercises negatively, such as sit and down, always sequencing them in the same order. Numerous other potential imbalances may emerge during training, some beneficial and others detrimental to training objectives. The single most important consideration to keep in mind to avoid problematic imbalances is to engender in the dog a confident attitude with respect to its ability to predict and control significant events, whether attractive or aversive. Dogs that habitually fail to exercise control over significant outcomes, particularly aversive ones, may develop a pattern of inflexible and ritualistic behaviors to cope with difficult situations. Even though such rituals are ineffective as means to control attractive and aversive events, they may serve to reduce distressing arousal (e.g., escalating anxiety and frustration) associated with behavioral incompetence. Behaviorally incompetent and insecure dogs tend to prefer familiar activities that minimize the risk of failure, even though they produce a low rate of reinforcement, whereas competent and confident dogs are more willing to engage in risk-taking activities and experimentation (actions with uncertain outcomes) to produce an optimal range and quantity of reward and safety. Perhaps the best general strategy to ensure beneficial balance is to encourage the dog to engage in behavioral experimentation that involves a balance of both attractive and aversive events arranged to occur with sufficient difficulty to increase the dog's functional competence and confidence.

Punishment and Aversive Counterconditioning

Radio-controlled e-collars are commonly used to punish (suppress) unwanted behavior. Since the intent of punishment is to produce rapid and complete suppression of the target behavior, the process typically involves significantly higher levels of stimulation than used to shape behavior with negative reinforcement. As a result, the levels of ES used for punishment purposes pose significantly more risks and potential problems than those associated with LLES. The more aversive the stimulation, the more accurate and precise the stimulation needs to be in order to avoid problems. Consequently, HLES is typically delivered in the form of a brief pulses lasting a fraction of second. Only e-collars incorporating a momentary function that prevents overexposure to HLES should be used to deliver such stimulation.

In contrast to LLES, HLES is prone to produce a number of undesirable side effects that require a great deal of care and expertise to prevent or manage. HLES can produce significant pain, fear, and distress, aversive arousal that may persist in some dogs by becoming associatively linked with the context or neutral stimuli present during inappropriate or lengthy HLES. Instead of promoting escape/avoidance behavior with negative reinforcement, HLES risks indiscriminately producing fear of the place or things present at the moment of stimulation, causing the dog to acquire a lasting aversion toward them, even though they might be entirely irrelevant to the actual cause of stimulation. Further, rather than learning to emit behavior instrumental to escape or avoid the stimulation, the dog may simply learn to be afraid of it. The intense emotional arousal elicited by HLES may impede efficient learning or evoke undesirable reactive behavior, even aggression, in some predisposed dogs. Fearful or aggressive behaviors immediately preceding the cessation of aversive stimulation may undergo significant negative reinforcement. Consequently, a major concern associated with punitive procedures is the risk of generating and reinforcing highly undesirable behavior in place of the target behavior being punished. For example, punishing a dog with HLES when it jumps up on guests may cause it to avoid entering the foyer or, perhaps, depending on the dog's temperament and propensity for such behavior, elicit intense fear or aggression toward the visitor at the moment in which stimulation is delivered. Dogs that succeed in running through an electrical boundary may inadvertently learn to avoid ES by running through the field in the future. Such dogs may subsequently run through the boundary as quickly as possible when threatened by the warning tone rather than simply backing away from it.

Aversive counterconditioning is most often used to counter or offset the appeal of intrinsically reinforcing activities. These techniques are most often used to control activities or appetites that might threaten dogs with injury or death. The intent of such training is to instill a lasting aversion toward some object or place. For example, many dogs are fascinated and beguiled by the sound made by rattlesnakes. By applying an intense ES as the dog approaches a rattling snake, it learns, often after a single trial, to avoid such sounds and creatures. In aversive counterconditioning, an attractive stimulus is paired with a strongly aversive one. The goal is to reduce the appetitive value of the stimulus for the dog. Punishment, on the other hand, is primarily focused on reducing the frequency or strength of some instrumental behavior. A common problem involves dogs that persistently chase cars or bicyclists. Because cars and bikes are common things, causing a dog to become overly fearful and avoidant toward such things would not be desirable. Instead, the goal is to suppress the chase response itself by means of aversive stimulation. Successful suppression appears to combine both behavioral avoidance and object-place aversion, with the associated object-place serving as a discriminative stimulus signaling avoidance.

Electronic Training and Problem Solving

Electronic collars have been recommended and shown effective for the rapid suppression of numerous behavior problems, including

chasing after a variety of objects and other animals, territorial aggression, excessive barking, stealing and destroying household items, pica, coprophagia, aggressive-intent (lunging) behavior toward other dogs, compulsive behaviors (e.g., tail chasing), fence jumping and other boundary-escape behaviors, and refractory mouthing and biting in puppies (Polsky, 1994). Hart and Hart (1985) have described e-collars as an effective way to remotely punish misbehavior in dogs. Aside from the advantage of remote application, e-collars enable trainers to deliver a highly controlled stimulus, at variable intensities, with a degree of accuracy and consistency that is not available by any other means.

Electrical Stimulation and Excessive Barking

Although many authorities deem the use of bark-activated collars inappropriate for controlling nuisance barking at separation, such devices appear to exert a significant suppressive effect over separation-related barking behavior. In addition to producing a sharp reduction of barking at separation, many owners and trainers have noted a significant calming effect associated with the use of such collars. A survey of dog owners that used e-collars found that many owners noted that their dogs were calmer and "more settled" after its use. Those owners that used a bark-activated collar noted universally a calming effect (Coleman and Murray, 2000). A disturbing finding detected by this survey was that among the 30 respondents, only one dog was regularly permitted in the house. Aside from suggesting that excessive barking and roaming problems may be causally related to rigid exclusion of the dog from the household, it emphasizes the importance of preliminary behavioral counseling that focuses on quality-of-life causes that might underlie the etiology of such problems. Without identifying and modifying such contributing causes, reliance on punitive measures (electronic or otherwise) is a highly problematic and ill-advised strategy of behavior control. Beaudet (2001) has suggested that the use of bark-activated spray collars is an effective adjunct to control territorial and protective barking as well as barking associated with separation anxiety, fear, or compulsive etiologies. This is a somewhat unexpected benefit, especially if one considers separation distress to be an anxiety-based problem. Given such an emotional etiology, one would predict that startle should exacerbate the problem barking—not reduce it. How can this apparent paradox be resolved? First, obviously, not all separation-related barking is exclusively caused by anxiety, and this could account for many instances of improved behavior (see *Separation Distress and Coactive Influences* in Volume 2, Chapter 4). But, even in cases of separation distress where anxiety clearly appears to play a role, a significant number of dogs appear to improve rapidly after exposure to electronic training when an electrical or spray stimulus is used. In the case of ES, a plausible way to interpret these observations is in terms of relief/relaxation and emotional opponent processing that ensue after shock is terminated. According to opponent-process theory, aversive stimulation evokes slave affects of opposite hedonic valence (Solomon and Corbit, 1974). After repeated exposure to aversive stimulation, the slave or b-processes become progressively robust, pronounced, and sustained (see *Opponent-process Theory and Separation Distress* in Volume 2, Chapter 4). These opponent b-processes include the confluent evocation of relief and relaxation. Denny (1971), who has thoroughly studied this phenomenon in the laboratory (see *Safety Signal Hypothesis* in Volume 1, Chapter 8), has found that relief rapidly displaces fear shortly after the termination of shock and continues to build in strength for 10 to 15 seconds into the post-shock period. This relief response is primarily autonomic in nature and gradually followed by a more generalized relaxation response. Paradoxically, so long as aversive stimulation is brief, escapable, and spaced in time, the net result predicted by opponent-process theory and the safety-signal hypothesis is progressive relaxation—not increased anxiety. In the case of separation-related barking, added beneficial effects may accrue as the dog learns to avoid

stimulation by not barking. Theoretically, each time the impulse to bark is inhibited, thereby avoiding stimulation, the dog may experience repeated and deepening episodes of relief, relaxation, and enhanced confidence. If this theoretical assessment is accurate, the overall emotional effect of such training is progressively to generate a very significant internal counterconditioning influence, perhaps of sufficient magnitude to offset anxious arousal during periods of separation. Additional benefits could be obtained by presenting a continuous olfactory safety signal timed to coincide with the onset of relief following ES and continuing for 3 minutes, thereby overlapping both the relief and the relaxation stages of the opponent process. A bark-activated collar could be designed and programmed to perform this task. In addition, the collar could periodically deliver the odorant in small, nonstartling amounts at variable times so long as barking has been absent during the period immediately preceding the odor's presentation. The use of an intermittent olfactory safety signal would serve to calm and reassure the dog while simultaneously reinforcing quiet behavior.

Whether one chooses to use a bark-activated spray collar or an e-collar, such devices must be used with great care with dogs exhibiting separation distress with coactive anxiety or panic symptoms. Bark-activated collars work because they produce a strong inhibitory effect over barking, but, in some dogs, instead of calming them as previously suggested, such devices may evoke increased excitability, distress, or even global panic. One illustrative case involves a female Brittany spaniel that was 11 years old when her owner moved into an exclusive high-rise condominium and had gone back to work after a long hiatus between jobs. The dog's reaction to this change in routine was to bark continuously and to eliminate whenever the owner left her alone. According to the owner, both of these problems arose only after the change in home and routine. The dog's incessant barking led to a flurry of nasty complaints by her new neighbors. The owner consulted a veterinarian (her brother) who recommended that she use a crate and a bark-activated e-collar. Rather absentmindedly, she put the collar on the dog and left her alone in the crate for the day. She later confessed that she had rushed out of the apartment to avoid hearing the dog yelp when the collar went off. When the owner returned home, she discovered to her horror that the dog had broken out of the crate. The dog's efforts to escape from the crate had resulted in severe lacerations of her feet and caused her to break off several teeth. The dog was covered in urine, feces, and blood—materials that were tracked and smeared into carpets and furniture. This is a rather exceptional case, but it does underscore the potential dangers involved when using crates or antibark devices to control separation problems. Such tools should be recommended with great care and their use avoided in the case of highly unstable and reactive dogs.

Electrical Stimulation and Refractory Compulsive Behavior

Refractory compulsive behaviors are a source of considerable distress for many dogs and owners. In addition to evidencing psychological stress, such problems often result in physical injuries to dogs. Compulsive habits may persist despite intensive behavior-modification efforts, prompting the use of various means of physical restraint and medical interventions involving psychotropic drugs. Excessive self-directed licking may result in acral lick dermatitis (ALD) (see *Excessive Licking* in Chapter 5), which is often associated with dermal hyperplasia and ulcerated lesions developing on affected areas, especially the carpus and tarsus joints. ALD may resist treatment efforts unless the dog's licking activity can be prevented. Prevention measures often include the use of Elizabethan-type collars, bandages, or various repellents applied to the affected area. Some of the treatments may cause the dog significant discomfort (e.g., glucocorticoids injected directly into the lesion) and require repeated administration. Although various pharmacological agents (e.g., clomipramine and fluoxetine) may significantly attenuate the habit, the benefits of such medications to control excessive licking depend on the sus-

tained use of the drugs, with the unwanted behavior often recurring when the medication is discontinued. Not only are the long-term side effects of prolonged psychotropic medication unknown in dogs, such medications are relatively expensive and may represent a significant strain on the household budget of many dog owners.

Eckstein and Hart (1996) performed a study to evaluate the use of radio-controlled ES to suppress excessive licking associated with ALD. The five dogs selected for the study were equipped with an e-collar (Tri-Tronics), providing the delivery of three momentary stimulations (3.3, 13.2, and 59.0 msec). Owners were instructed to use the minimum duration of stimulation needed to interrupt licking behavior. For all dogs, the medium duration (13.2 msec) was sufficient to inhibit licking. Initially, the owner delivered the stimulation while hidden from the dog's view, but, as the training progressed, ES was delivered in different contexts, including at times when the dog was in the owner's presence. Between training sessions, dogs were required to wear Elizabethan collars, at least until licking had been absent or rare for 6 hours or more. On average, licking was suppressed in four of the five dogs after a mean of 11.8 electrical events delivered over 12 to 50 days. The suppressive effect of the protocol was highly durable, and relapse was quickly resolved with a brief period of remedial training. The variable length of time required to obtain full suppression may have been due to differences in the amount of time owners devoted to the training program.

Considering the extremely rapid and lasting benefits derived from a dozen or so brief pulses of momentary ES, the procedure described by Eckstein and Hart would seem to represent an important advance in the humane treatment of such problems. A significant advantage of the procedure is its simplicity—a factor that recommends its use by average dog owners. Interestingly, though, Hewson and Luescher (1996) have criticized the method as being too difficult for the average owner to follow because "the technique was used according to a particular protocol, something most owners cannot do" (156). Oddly, they then go on to recommend an arguably more complicated protocol requiring that the owner train the dog to perform some response that is incompatible with licking. When licking occurs, the owner is instructed to distract (startle) the dog from the activity by blowing on a duck call or shrill whistle, whereupon it is cued to perform the incompatible response. This general procedure is repeated every time the dog licks during the 6-week treatment program. In addition, the authors recommend that the owner never "rebuke or punish" the dog since such treatment might worsen the problem, but offer no concrete evidence supporting their rationale or data demonstrating the effectiveness of their treatment protocol. Eckstein and Hart preemptively respond to potential "humane" criticisms, writing,

> The use of electronic shock collars may be questioned by some animal handlers; however, compared with the discomfort of intralesional injections, prolonged use of Elizabethan collar, or both, a limited number of momentary shocks should be considered a humane alternative. (1996:226)

Employing ES in the treatment of ALD should include a preliminary veterinary examination and appropriate treatment of any active lesions. The trainer should attempt to identify and remove sources of behavioral stress adversely impacting the compulsive habit. The long-term benefit of electrical conditioning for the control of ALD is enhanced by the incorporation of various enrichment and training programs. In addition to daily exercise and social activities involving play and compliance training, various counterconditioning efforts involving the use of food and massage should be employed. If an e-collar is selected to help control excessive licking, the dog should be first properly introduced to it in the context of safety training. *Safety training* involves a strategy designed to enhance a dog's control over aversive events while simultaneously exploiting the inherent relief/relaxation effects associated with the successful escape and avoidance learning. The dog learns that ES is controllable and safe by the trainer introducing it at low levels—those just suffi-

cient to reinforce previously conditioned orienting and basic obedience exercises (e.g., sit and stay). Such preliminary training helps to reduce the risk of inducing undesirable fear or stress in association with aversive training.

Using ES to train a dog not to lick should consist of three phases: escape, avoidance, and reinforcement of an alternative behavior. During the escape phase, LLES is applied to interrupt licking. The moment the dog stops licking, a conditioned negative reinforcer (e.g., "Good" or click) is presented and the e-stimulus is immediately turned off and the vocal signal "Relax" is delivered. The avoidance phase of training involves the presentation of a vocal avoidance signal (e.g., "Stop") just before the e-stimulus is activated. By responding immediately to the avoidance signal, the dog can avoid the presentation of the e-stimulus. With the cessation of licking, the dog is tossed a treat or toy, thereby further reinforcing the response and providing the dog an alternative outlet for oral activity.

Once the dog learns that it can escape or avoid the e-stimulus, a more aversive event can be introduced with the goal of further suppressing the compulsive ritual. Now, if the dog fails to respond immediately to the avoidance cue "Stop," a momentary stimulus consisting of a stronger intensity is delivered, depending on the dog's sensitivity to ES. During this phase of training, a dilute odor and repellent taste can be applied sparingly to the area with a cotton squab, thereby providing an additional reminder not to lick the area. As the result of aversive ES, significant emotional relief typically follows within 3 to 5 seconds, with opponent relaxation building after another 2 to 3 minutes. During the relaxation phase, a safety odor (e.g., citrus scent or dilute lavender) can be presented together with a toy and reassuring affection. The idea is to associate the odor with relaxation while redirecting the licking activity away from the dog's body toward a toy. This procedure is repeated as necessary. The e-stimulus involved need not be too intense, but it should be strong enough to suppress the licking behavior rapidly (see Eckstein and Hart, 1996). Although the initial sensitizing exposure should be moderately strong, subsequent stimulations can be milder, with the voice reprimand "Stop" often being sufficient. For optimal effectiveness, the e-stimulus should be paired with the earliest intentional movements anticipating a licking episode. A radio-controlled spray device (with or without odorant) might also be useful for such purposes. To guard against excessive contextualization, the dog should be observed in various situations and ES appropriately applied, as needed. Finally, it is particularly important to observe and apply ES with the owner both in and out of the dog's view. A remote wireless camera can be very effective for such purposes. Between sessions, the dog should wear an Elizabethan collar until it is evident that the licking compulsion has abated. In all cases, daily basic training should be performed together with exercise, play, massage, and other quality-of-life enhancements, as appropriate. In addition to providing an effective alternative for refractory ALD, electrical training is a viable adjunctive treatment procedure for the control of a variety of other compulsive habits requiring immediate interruption and precise timing of aversive stimulation (e.g., tail chasing and whirling).

Electrical Stimulation and Aggression

The value of electronic training for the control of aggressive behavior has been known for many years, but procedures incorporating ES remain a lightning rod for controversy. A common and erroneous allegation suggests that ES elicits aggression in dogs or makes aggressive dogs more aggressive. While it is certainly possible that exposure to a highly aversive and uncontrollable e-stimulus may elicit aggressive panic and phantom snapping in some reactive dogs, ES delivered in measured and controllable doses can be effectively used to enhance behavioral control in dogs prone to show aggression in response to direct control or restraint techniques. LLES has been recommended as an adjunct to other behavior-therapy efforts for the control of noncompliant behavior associated with dominance aggression (Borchelt and Voith, 1996). Of course, ES is used only for dogs not likely to escalate aggression in response to such

stimulation. ES can be particularly useful in the treatment of location- and object-guarding behavior, providing a highly effective way to compel the dog to relinquish control over some location or object while channeling incompatible safety-seeking behavior toward the trainer. The power of ES to control aggression is probably the result of the dog learning that compliance and cooperation are more effective than aggressive threats and biting as a means of controlling such events. The net result is twofold: (1) a rapid disconfirmation of established prediction-control expectancies and establishing operations mediating aggressive threats and attacks, and (2) the establishment and subsequent confirmation of alternative prediction-control expectancies and establishing operations that promote social behavior incompatible with aggression.

When properly introduced and applied, ES does not typically cause dogs to escalate aggressive behavior, but generally exerts an opposite inhibitory effect. If delivered well in advance of the flash point of no return (see *Proactive versus Preemptive Processing and Cynopraxis* in Chapter 8), the most common effect of contingent ES is to trigger behavioral inhibition and deescalate aggressive arousal. In the context of a comprehensive cynopraxic therapy program, most dogs showing mild to moderate aggression problems appear to become increasingly pacified, relaxed, and cooperative as the result of exposure to radio-controlled training, provided that the preliminary reward-based training and enhancement procedures, as described previously, are carried out by a competent and skilled cynopraxic trainer. In particular, radio-controlled ES or vibrotactile stimulation can be highly effective for the control of intraspecific aggression—especially aggression between dogs sharing the same household. When brief LLES/MLES or vibratory stimulation is applied in a timely manner, such that an incipient threat sequence or juncture responsive to de-escalation is overlapped by the contingent presentation and cessation of ES, the stimulated dog usually shows a pattern of phasic inhibition and attenuation of aggressive arousal, followed by a heightened responsiveness to vocal command and trainer control efforts. In the context of escalating interdog tensions, ES may cause the provocative dog to emit postural and intentional changes that the target dog may interpret as signifying cutoff or submission, causing both dogs to adopt a motivational shift incompatible with fighting. Many target dogs exhibit an unsettled appearance after observing the unexpected and rapid shift in intent and behavior shown by the stimulated provocator, and appear to be surprised and concerned about the unknown cause of the change. In addition to helping to defuse aggressive tensions between the dogs, the motivational shift (establishing operation) evoked at such times is conducive to the integration of alternative behavior previously acquired in the context of reward-based training. Finally, radio-controlled ES enables a trainer to manage proxemic distances and dynamics between potential adversaries while minimizing the risk of producing adverse interference effects that might otherwise occur as the result of direct interactive control efforts.

Undoubtedly, aversive stimulation can cause certain dogs exhibiting a reactive coping style to respond with fear and escape behavior or even to show autoprotective aggression, especially when escape is barred and the stimulation is perceived as otherwise uncontrollable or extraordinary in terms of threat magnitude. However, under structured and controllable circumstances, ES may also be used to temporarily attenuate or even permanently suppress aggression in dogs (Tortora, 1983). When confronted with an aversive social event, a dog is prone to exhibit a combination of two general coping patterns or *styles*, depending on the severity of the event and the degree of control it perceives to have over the event. Threatening aversive events perceived as lacking controllability tend to preferentially activate the flight-fight system (FFS) and prompt reactive adjustments, whereas safe aversive events perceived as predictable and controllable tend to facilitate adjustments in accord with acquired prediction-control expectancies and calibrated establishing operations, thereby promoting competent and confident adjustments. In safe

aversive events, the positive hedonic processing and rewards associated with repeated escape to safety appears to antagonize and countercondition elicited fear stimulated by the event, thereby gradually reducing reactive escape-from-fear adjustments. That aversive events exert variable effects on dogs is consistent with the presence of individual temperament differences and differentiating learning experiences affecting the way dogs cope with and perceive aversive social challenges and threats. Whereas social challenges and threats perceived as such may invigorate aggressive behavior in dogs operating in accord with a reactive coping style, social challenges and threats perceived as safe and controllable tend to promote adjustments conducive to appeasement and reconciliation.

Obviously, significant conflict is apt to occur if the trainer is viewed by the dog as both the source of aversive stimulation and the provider of guidance and safety. Consequently, efficient safety training depends on the dog not linking the e-stimulus with the trainer. When stimulated, the dog should learn to look to the trainer for help while learning to escape and avoid the e-stimulus. In an important sense, the trainer should be perceived as a source of safe guidance to the dog, providing commands, hand signals, conditioned reinforcers, and leash prompts while helping the dog to escape and avoid the aversive event while learning to obtain safety and the comfort of various other rewards controlled by the trainer (e.g., play, massage, petting, and food). Consequently, in addition to reducing aggressive behavior and promoting prosocial behavior, radio-controlled training may enhance attachment dynamics and communication between the trainer and the dog. Finally, insofar as the dog perceives the trainer as a source of safety (relief and relaxation), the trainer may also acquire potent and lasting reward properties (see *Electrical Stimulation and Harm to the Handler-Dog Bond*).

Many types of canine aggression have been described and categorized according to the eliciting situation or motivational states presumed to mediate the threat of attack (see *A Nomenclature of Aggressive Behavior* in Volume 2, Chapter 6). Tortora (1983) has subsumed several common types of aggressive behavior under the functional category of avoidance learning, suggesting that aggression is often learned as a means to control aversive social situations (see *Avoidance Learning and Aggression* in Volume 2, Chapter 6). According to Tortora's hypothesis, aggression toward people is learned via escape/avoidance (negative reinforcement) conditioning involving stressful or threatening situations. By training a dog to escape or avoid aversive or threatening stimulation with cooperative behavior, avoidance-motivated aggression is gradually replaced with a repertoire of behaviors that are incompatible with reactive opposition and aggression. Learning to successfully escape or avoid aversive stimulation promotes the development of expectancies of safety, further enhancing the dog's ability to cope with adverse social interaction in a more confident and prosocial way.

To achieve this change, Tortora devised a controversial program for rehabilitating aggressive dogs. The protocol focused on training dogs to perform 15 basic obedience exercises (AKC-CDX). The initial training process involved object and interactive play and force training. Training progressed from a continuous schedule of reinforcement, where every correct response was rewarded with play, to an intermittent schedule [variable ratio (VR) 5 and, eventually, VR 15]. Once the 15 exercises selected were under basic control, training with ES commenced. During the training process, the selected exercises were shaped through progressive stages to meet demanding performance criteria. In addition to training on the kennel grounds, the dogs were conditioned to respond reliably under a variety of circumstances:

Sidewalks with pedestrians and traffic
Busy shopping malls
A local shelter with many barking dogs
Household-type environments
A classroom with 20 to 60 students

Escape training was initiated with LLES just sufficient to get the dog's attention but not eliciting fearful behavior. The level of ES was progressively increased during training, until the dogs could tolerate and perform

under HLES. As the dogs emitted the appropriate escape response, a safety signal consisting of a tone was immediately presented as the e-stimulus was turned off. The arrangement was designed to establish a conditioned association between the tone and poststimulation relief and relaxation. Poststimulation relief and relaxation serve to positively reinforce escape/avoidance behavior, as well as evoke a state of emotional arousal incompatible with fear. Conditioned stimuli repeatedly paired with the onset of relief and relaxation can gradually acquire the ability independently to elicit similar states of arousal and be employed to countercondition fear. Denny (1983), commenting on Tortora's study, summarized the significance of relief and relaxation in the process of safety training:

> Relief is conceived of as a short latency, autonomic event that lasts only 15 to 20 sec. Relaxation, on the other hand, seems to be a long latency, striate muscle event that requires at least a 2.5-min nonshock period to be effective. Both relaxation and relief are assumed to be effective in making the stimuli associated with a nonshock period positive, or safe, during the acquisition of avoidance and in providing the responses that can compete with fear and help mediate its extinction. According the theory, both relief and relaxation occur automatically with the extended removed of an aversive or well-conditioned aversive stimulus. Nothing else is required. (215)

In addition to establishing a safety signal, a warning vibrotactile buzz (conditioned avoidance stimulus) was presented just after the command. The dogs learned that they could escape ES by quickly performing the required obedience response or what Tortora refers to as an *operand*. With the emission of the target response, the safety signal was delivered for 2 seconds. An avoidance procedure brought the obedience response under the stimulus control of a command. By responding in a timely and correct manner, a dog could avoid ES and produce the positive reinforcement via the safety signal and play. During the avoidance-training phase, progressive improvement was observed in the dogs' performance, even though ES was no longer delivered. Gradually, both the safety tone and periods of play were placed on an intermittent schedule. As dogs reached this point in the training process, they were exposed to various stress and distraction tests designed to maximize the generalization and transfer of safety training. Dogs were tested for aggressive propensity "under maximally stressful and aggression-inducing circumstances, for example, while the animal was roughly handled and beaten about the body with a rolled-up newspaper or switch" (1983:188). During this phase of testing, failure to comply with obedience commands or the display of aggressive behavior was followed by the delivery of HLES (full intensity). This final stage or *normalization* also involved phasing out the e-collar and transferring the trained behavior to the dog's home environment.

Tortora treated 36 dogs with the foregoing protocol. The reported results are very impressive, with all treated dogs showing a "complete and permanent" cessation of aggressive behavior. Tortora observed a number of other benefits directly attributed to safety training:

> Produces highly durable and reliable compliance responding
> Reduces fear and other stress reactions
> Promotes an appearance of enhanced confidence in the dog

Tortora's work appears to reveal several significant factors in the acquisition and control of aggression in dogs, but the treatment program is rather extreme and may benefit from various refinements and modifications. The general protocol may be made more effective and usable by minimizing aversive stimulation while maximizing the use of positive reinforcement, play, and safety conditioning. The use of full-intensity HLES and other procedures involving provocative and aversive handling of dogs raises significant welfare concerns. Tortora does not demonstrate the necessity of such highly aversive and potentially traumatic experiences for effective safety training. Further, dogs selected for the study were exposed to the same general procedures irrespective of temperament and individual sensitivity differences. The treatment protocol was identical for different dog breeds exhibit-

ing varying behavioral propensities (Saint Bernard, German shepherd, chow chow, Dalmatian, standard poodle, springer spaniel, and Kerry blue terrier, among others). Also, positive reinforcement was limited to the safety signal and an opportunity to play—an activity that is not equally rewarding for all dogs, especially those with a history of aggression. The schedule of intermittent positive reinforcement used to maintain the repertoire of obedience responses was extremely lean—probably unnecessarily so. Perhaps significant benefit and minimization of aversive stimulation could be achieved by presenting food and other rewards on a more dense frequency of reinforcement that incorporates positive prediction error.

Another potential improvement in the protocol would be the use of an olfactory safety signal in combination with or in place of an auditory one. In contrast to the 2-second safety tone paired with relief following the termination of aversive stimulation, an olfactory stimulus (e.g., dilute lavender or chamomile) can form an association with the more sluggishly recruited relaxation responses, as well. In addition, the incorporation of vocal praise and encouragement with petting and massage would provide another form of constructive safe stimulation to pair with relief, perhaps helping to enhance relaxation and establishing more positive associations with human contact. An advantage of conditioning voice and tactile stimuli as safety signals is the ease with which they can be generalized and transferred to everyday activities in a dog's home environment. The benefit of pairing a sustained olfactory stimulus or set of social stimuli with both relief and relaxation may be significant for the maximization of the benefits of safety training and the promotion of trust between the dog and the trainer. Denny (1983) notes, in his comments regarding Tortora's report, that conditioned safety effects are doubled when the safety stimulus is paired with both relief and relaxation. Given the central significance of the safety signal in the safety-training protocol outlined previously, it is odd that the e-collar is gradually faded out and eventually removed from a dog altogether as part of the final normalization phase of training. Removing the collar from the dog appears highly problematic, because the delivery of the safety signal depends on the collar to deliver the requisite conditioned tone. This loss of signaling capability seems inconsistent with the repeated emphasis and importance placed on the safety signal for reducing fear and aggression and its value as a source of positive reinforcement for compliant behavior. In contrast, olfactory, vocal, and tactile conditioned safety signals would avoid such difficulties, perhaps enhancing the process of generalization and transfer, as well. Despite the apparent effectiveness of safety training for the treatment of aggression in dogs, the protocol has attracted little interest and, to my knowledge, has not been experimentally replicated, although safety training using ES offers many potentially beneficial applications in canine behavior therapy.

Electrical Stimulation and Chasing Behavior

Another common application of ES in dog training is the control of chasing and predatory behavior. The radio-controlled and behavior-activated delivery of ES has been proven effective for suppressing predatory behavior in dogs, coyotes, and wolves (see *Electronic Training and Wildlife Conservation*). For example, Andelt and colleagues (1999) at the National Wildlife Research Center's Predator Research Facility (Logan, Utah) found that HLES rapidly suppressed coyote predatory behavior toward lambs. Even when ES was delivered during attack, the researchers reported immediate suppression and no evidence of escalation or increased aggressiveness. In Norway, Christiansen and colleagues (2001a) evaluated the use of remote electronic training for suppressing canine predatory behavior toward sheep. The study period was 2 years and involved 114 dogs, consisting of three breeds: Norwegian elkhounds (35), English setters (56), and hare-hunting dogs (23). The dogs were administered a 1-second pulse of ES when they approached within 1 to 2 meters of sheep confined to a pen. The researchers found that a lasting suppression of predatory

behavior was produced by the protocol (Christiansen et al., 2001b). After a year, only one dog that received ES training continued to attack sheep. The effect showed significant generalization to ordinary circumstances, with approximately 75% of the owners of trained dogs reporting that their dogs no longer showed an interest in sheep. Similarly, Stichnoth (2002) has demonstrated that the chase and hunting behavior of beagles can be rapidly suppressed with the aid of radio-controlled ES, without producing evidence of cardiovascular distress or physiological stress. As an adjunct to reward-based training efforts, radio-controlled ES can also be used to rapidly and effectively suppress the chasing of cats and other animals by dogs. Despite ample evidence that ES works effectively to control chasing and predatory behavior, organizations such as the Companion Animal Behavior Therapy Study Group (CABTSG) continue to suggest otherwise, but without offering any substantive research to backup their emotional convictions and charges of harm and ineffectiveness (CABTSG, 2003). In addition, they suggest that other methods are currently available that have been proven to provide better control and management of such problems, but fail to identify a method or offer a single citation referring to the powerful methods of control in question. Instead, they vent an emotionally charged diatribe of speculation that is largely contradicted by the prior research previously discussed.

Several advantages are derived from the radio-controlled application of aversive stimulation for the control of behavior problems associated with chasing behavior: It provides an exact level of stimulation, can be precisely timed and delivered at a distance, and helps to generalize training to situations in which the owner is absent. With a proper foundation of positive training in place, radio-controlled electrical or spray (e.g., citronella spray) stimulation offers a highly effective means to inhibit the territorial chase response in resistant dogs. Although electronic training can effectively deter persistent chasing behavior in dogs, the use of spray stimulation or ES should be considered only after a careful assessment and preliminary training have been carried out. Once preliminary training has been performed, electronic training can help to enhance the reliability of inhibitory control.

Initially, the dog is exposed to recall training on a long line, with electronic training introduced only after the dog attains 90% reliability. The dog should be trained to orient to its name and halt forward movement in response to the command "Stay" spoken assertively. The orienting response can be effectively conditioned with LLES, whereas the inhibitory halt response may require a higher level of momentary stimulation to reach reliability. Electronic training should be combined with a conditioned stimulus (e.g., whistle or throw rings). By blowing a whistle or tossing a set of throw rings close to the dog immediately before and contiguous with the electrical event, a strong inhibitory association can be rapidly established. After pairing the throw rings with the e-stimulus, the jingling sound will produce a strong inhibitory response, providing an effective means to generalize a conditioned suppressive effect. Prior to every ES event, the throw rings are flipped once in the hand. The rings should be thrown only if the dog ignores the warning and requires remote stimulation. The throw rings need not strike the dog, but should bounce near enough to produce an impression. During the early stages of electronic training, the dog should be kept on a long line to ensure that the appropriate response is given during ES and to prevent unanticipated problems.

Electronic Training and Wildlife Conservation

In addition to select dog-training and behavior-therapy applications, electronic training devices may play a significant future role in the management of wildlife, particularly tracking and deterrence systems used to protect endangered species or livestock from predation. Several studies have used radio-controlled or behavior-activated collar systems for predator control. For example, conservationists working in California found that foxes living on San Clemente Island preyed on nestling loggerhead shrikes (*Lanius ludovi-*

cianus mearnsi), a severely endangered bird species living on the island. Wildlife biologists affiliated with the Institute for Wildlife Studies (2000) employed an ordinary electronic dog-containment system to deter fox predation on shrike nestlings. Whenever the collar-equipped foxes came too close to the shrike nests, an electrical shock was delivered, thereby protecting the nestling shrikes from harm and training the foxes to avoid the nests. The technique of electrical deterrence was studied as an alternative to lethal control that would have been otherwise necessary to protect the shrikes from further decimation.

A similar effort to develop a predator-deterrence system has been launched by the U.S. Fish and Wildlife Service (USFWS) and U.S. Department of Agriculture (USDA) Wildlife Services, with the cooperation and support of the University of Montana and prominent wildlife conservationist groups. The objective of the study, under the scientific direction of John Shivik (USDA Wildlife Services), is to explore the efficacy of aversive electrical conditioning to control undesirable predation by wolves. Wolves that prey on domestic animals are often killed when other means of control fail. Four wolves suspected of repeated attacks on cattle were captured north of Gardner, Montana. The controversial experiment consisted of fitting the three surviving wolves (one of them, an adult female, died while in captivity) with containment dog-training collars and penning them with a calf fitted with an approach-activated transmitter. When wolves wearing radio-controlled collars approached the calf too closely, a brief tone stimulus was followed by the delivery of an ES producing "discomfort but not pain" (Bangs, 2000c). Successful deterrence has been reported with coyotes fitted with e-collars. Attack-contingent ES quickly conditioned coyotes to avoid attacking lambs that were placed in their pens (Andelt et al., 1999). Treated coyotes were exposed to the highest level of stimulation produced by the Tri-Tronics Model 100 Lite (325 pulses/second of 600 to 640 V at about 32 mA). The coyotes rapidly acquired a lasting avoidance of sheep that continued for several months after treatment without intervening electrical reinforcement.

Besides investigating the efficacy of aversive control on livestock predation, the researchers hope to learn whether treated wolves will desist from predation on cattle once the wolves are released into the wild and transmit the aversion as a tradition to other wolves subsequently raised by the pack. According to Bangs, the Wolf Recovery Coordinator for the USFWS, researchers in the former USSR (Republic of Georgia) successfully conditioned wolves with dog collars to avoid livestock when released from captivity. In addition, future generations of wolves learned through cultural transmission from the behavior of conditioned wolves to avoid livestock as prey animals. Research with dogs has not produced very promising results in this regard (Christiansen et al., 2001c). Sheep-chasing dogs paired with sheep-avoidant dogs (previously exposed to ES) showed an initial reduction in chase incentive but over time exhibited an increasing tendency to chase and attack sheep independently.

In the ongoing wolf experiment, preliminary results suggest that wolves may rapidly acquire an aversion toward calves as the result of approach-activated ES (Bangs, 2000a). One wolf that approached a calf hide with a transmitter placed on it was apparently stimulated, because it jumped back from the hide and avoided contact with it in the future. Other pack members watching the stimulated wolf's reaction seemed to have also acquired an avoidance response by observation. None of the three wolves subsequently approached the calf hide after the frightening incident. Further, avoidance behavior toward the calf hide appears to have generalized to live calves, at least temporarily. Calves were repeatedly left alone with the wolves, with one young calf spending a night in the wolf pen without evidence of molestation. It remains uncertain whether the avoidance is the result of predatory inhibition resulting from nervousness associated with close confinement or the result of the single (known) exposure to ES. Whatever the cause, the inhibition was not permanent, since the wolf that had been previously stimulated did finally attack a calf. Unfortunately, the collar either malfunctioned or the electrodes failed to reach the skin

through the wolf's thick fur. Subsequently, the collar was repositioned for better contact with the skin, evidently correcting the problem, since a November update (Bangs, 2000b) noted that the calf now could follow or chase the wolves around the pen, having apparently learned to use the power afforded by its collar transmitter.

The use of conventional containment-type collars for predator deterrence is thwarted by significant design and operational problems. The long-term use of collars delivering ES through metal electrodes making direct contact with the skin is prone to produce skin irritations, gradually resulting in necrotic lesions and infection. Another problem with such devices is the need to change or recharge batteries periodically—a problem that might be solved by incorporating a miniature solar-recharging system integrated into the strap of the collar. The problems associated with the electrode-skin interface might be addressed by a high-voltage collar with the ability to arc through the fur barrier or by an e-collar equipped with electrodes that are only momentarily brought into close contact with the skin through a servomechanism activated at the time of stimulation.

Electrical Stimulation and Working Dogs: A Shocking Study

Electrical stimulation is frequently used in the context of training working dogs, aiding the trainer in establishing reliable control over highly motivated and potentially dangerous behavior. Schilder and Van der Borg (2004) have published a report of disturbing findings regarding the short-term and long-term effects of shock used in the context of training working dogs that is destined to become a source of significant controversy. The authors arrived at their conclusions after observing several training sessions and analyzing video records of Dutch handlers preparing dogs for IPO [Internationale Prüfungs Ordnung (International Examination Rules)] certification. The authors report that they observed 32 dogs receiving 106 shocks delivered by a radio-controlled collar. In addition, they combined the results of comparisons between 31 German shepherd dogs divided into shocked and nonshock groups, with 16 dogs (14 males and 2 females) receiving shock and 15 (12 males and 3 females) not receiving shock during training. The main differences observed between dogs receiving ES and those receiving other forms of correction included an altered ear posture detected during obedience work and free walking, tongue flicking (appeasement licking) during protection work, and submissive pawing actions during obedience work.

Electrical Stimulation and Harm to the Handler-Dog Bond

According to the authors, even brief and infrequent shocks may be perceived as traumatic by dogs, causing them emotional harm and permanent social fear. The notion that Dutch working dogs might have become fearful of their handlers as the result of shocks received in training is reported as an obvious fact that is never actually tested, leaving it to the reader to accept the speculation "as fact" or not. In practice, dogs do not appear to link ES with the handler, especially persons with whom the dog is closely attached and familiar. In fact, the most interesting uses of the collar depend on this lack of aversive association, including lasting reward and opponent safety effects (Denny, 1991). Interestingly, the IPO system has devised a good behavioral test for detecting mishandling and abuse. Surely, if an IPO dog had developed a fear or aversion toward its handler as the result of electrical training, the following IPO Watchdog Test [WH (Wachhunde Certificate)] requirement would likely reveal it, causing a great many dogs to fail if they were treated as badly as alleged by the present report:

> Devotion to the Handler (10 pts)
>
> The dog is put on lead and handed over to a second person. The handler then proceeds toward a group of people who are standing about 80 paces away. The dog is allowed to watch the departure of his handler until the handler has gone about 30 paces of the distance. At this point, the dog is taken behind a

> wall or similar structure so that his handler is no longer visible to him.
>
> When the handler arrives at the group, he walks into the center of the group and stops. While he is in the group, the handler may not make himself noticeable to the dog across from him. The dog is released from the lead by the second person. The behavior of the dog, especially the use of the nose, is to be observed during this exercise. When the dog has found his handler, he is to be praised. (Frawley, 2003)

If the electrical and physical stimulation during protection work were truly traumatic and stressful, one would expect that the traumatized dog might be apt to flee at the first instant it got a chance. Further, one would expect that its willingness to bite and hold the sleeve ought to decrease in proportion to the amount of fear and pain it experienced (e.g., causing the dog to come off the sleeve too early or not to bite as hard) or that the dog might even show signs of avoidance and fear toward the agitator. However, no such loss of drive or performance is reported. In fact, Dutch dogs are renowned for their hardness, work enthusiasm, and acrobatic attacks—attributes that are opposite to what one would expect from training that was overly stressful. With increased biological stress, as in sickness, one would expect to observe a drive-reducing effect on aggression and a loss of voluntary initiative, whereas increased fear should tend to suppress behavior rather than enhance it. The absence of reduced drive or behavioral suppression with respect to critical activities associated with shock (e.g., bite work) makes one skeptical about the lasting adverse effects that the authors claim to document. Although they offer no substantive evidence of trauma or harm to the dogs, they provide loads of speculation, anecdotes, insinuations of gender and educational inadequacies, and derogatory comments regarding the motivation and competence of IPO trainers in its place.

Most scientific evidence supports the notion that the cessation of aversive ES in the context of escape/avoidance training is more likely to enhance social attraction, promote feelings of safety, and calm a dog rather than make a dog afraid or apprehensive. These secondary effects of shock termination and pain reduction have long been recognized to promote conditioned and unconditioned effects conducive to reward and safety (see *Electrical Stimulation Controllability and Safety*). Instead of instilling social aversion and anxiety as suggested by the authors, competent electronic training may actually promote social attachment, reward, and safety. With the behavior-contingent cessation or avoidance of ES, dogs experience immediate emotional relief that subsequently merges into a state of progressive relaxation incompatible with social aversion and fear—a sequence of opponent emotional effects contrary to those alleged to occur in the case of working dogs exposed to ES in the context of training.

The opponent effects of relief and relaxation on social behavior are exemplified in a series of controversial experiments that used shock to promote desirable social behavior in profoundly autistic children. Lovaas and colleagues (1965) at the University of California, Los Angeles, used ES and its contingent termination to facilitate the expression of increased approach and affectionate behavior based on the following hypothesis:

> Any stimulus which is associated with or discriminative of pain reduction acquires *positive* reinforcing (rewarding) properties, i.e., an organism will work to "obtain" stimuli which have been associated with pain reduction. The action of such stimuli is analogous to that of stimuli whose positive reinforcing properties derive from primary positive reinforcers. (99)

The first of these experiments involved placing a child with pervasive emotional and social deficits between two experimenters who faced each other from a distance of 3 feet. Whomever the child faced encouraged him to approach closer with outstretched and gesticulating arms, saying "Come on" as a painful electrical current was delivered to the child's bare feet via strips of metal tape applied to the floor. If the child hesitated longer than 3 seconds, he was pushed forward into the beckoning arms of the "saving" experimenter by the other "helping" experimenter located behind the child. As the child moved in the direction of the experimenter, the shock stimulus was immediately terminated. In addition to rewarding social behavior via an escape to

safety, the shock stimulus was contingently applied to suppress tantrums and self-stimulatory behavior. According to the authors, the experiment was highly successful, with the children (identical 5-year-old twins) subsequently exhibiting improved alertness, increased social approach behavior, and more affectionate behavior to the experimenters—changes that lasted for 9 months without any additional aversive stimulation. The boys also exhibited a significant decrease in tantrum and self-stimulatory behavior stemming from the contingent application of shock, and this changed behavior continued for 11 months without additional training. In another experiment involving these same twins, a radio-controlled stimulator (Lee-Lectronic Trainer) was fastened to a belt and situated so that the electrodes made contact with the child's buttocks. Affectionate social contact (kissing and hugging) was encouraged by the experimenter, who faced the child and bowed in his direction, saying "Kiss me" or "Hug me." If the child, who was held fast at the waist, failed to kiss the experimenter or hug him, a medium-level shock was delivered via radio control. As the result of the foregoing procedure, the boys were rapidly trained to kiss or hug the experimenter on cue. In a third study again with these same twins, the researchers evaluated the effects of shock reduction and safety in terms of acquired reward properties associated with the experimenter. As the result of an association established between the experimenter, pain reduction, and successful escape to safety, the presence of the experimenter became a significant source of reward for the children, as quantified by lever-pressing behavior whereby the children were given brief contact with the experimenter contingent upon performance of the lever-pressing task. The authors conclude with the following remarks regarding the apparent beneficial effects of contingent shock escape/avoidance and pain reduction:

> It seems likely that the most therapeutic use of shock will not lie primarily in the suppression of specific responses or the shaping of behavior through escape-avoidance training. Rather, it would seem more efficient to use shock reduction as a way of establishing social reinforcers, i.e., as a way of making adults meaningful in the sense of becoming rewarding to the child … Once social stimuli acquire reinforcing properties, one of the basic conditions for the acquisition of social behaviors has been met. (108)

These theoretical and experimental findings have been repeatedly validated in the context of formal obedience training, where dogs initially showing profound social inhibitions and fears become increasingly affectionate, confident, flexible, interactive, and playful in association with directive training (see *Electrical Stimulation Controllability and Safety*). Despite a significant amount of aversive stimulation used in the context of traditional dog training, dogs exposed to such training typically acquire a heightened level of affection toward the trainer, who is usually treated as a social reward object. The petting and praise that are strongly emphasized in such systems of training mediate significant reward, perhaps as the result of a similar paradoxical effect in response to pain reduction and the successful escape/avoidance (safety) of aversive collar stimulation and physical force, paralleling the findings of Lovaas and colleagues.

Fisher (1955) exposed several groups of puppies to different rearing conditions consisting of variable amounts of environmental enrichment, social contact, punishment, isolation, and control over aversive events. From around week 3 to week 15, one group of puppies [enriched (E)] were given 30 minutes of daily exposure to various sources of environmental and social stimulation, receiving consistent friendly handling by the experimenter, and were never punished. Another group of puppies [ambivalent (A)] were given 30 minutes of similarly permissive and playful environmental and social stimulation followed by 30 minutes of repeated punishment, consisting primarily of manhandling and hitting with a switch. During the punishment period, whenever a puppy attempted to approach the experimenter or another puppy, it was punished. The puppy was also punished if it explored the test area or played in the experimenter's presence. When receiving physical punishment, the puppy could flee to the safety of a hiding place but was often removed from there and punished more. Elec-

tric shock (via a 50-V dry-cell battery regulated by potentiometer) was used to punish social approach behavior within a small inescapable compartment. The shock punishment was delivered to the puppies' feet under two conditions: (1) whenever two puppies approached each other within the compartment and (2) after a puppy approached an experimenter coaxing it from outside the compartment. Two other groups were kept isolated, except that one group of isolates [punished (P)] was also treated roughly and exposed to the daily punishment treatment as group A; the other group of isolates remained in their cages until final testing. During subsequent testing at weeks 12 and 13, four of the six puppies exposed to the pattern of indulgence and punishment appeared to view the experimenter as an enhanced source of reward and security, spending significantly more time in close proximity with the experimenter than did indulged puppies. However, two of the puppies exposed to the combined indulgence and punishment treatment showed a strong avoidance of the experimenter indicative of aversion, suggesting that individual differences of a genetic origin may affect the way dogs respond to such treatment (see Freedman, 1958). Interestingly, the indulged-punished group showed a significant reduction in general activity and exploratory behavior and reacted more intensely toward extraneous noises and movements than did the consistently indulged group, perhaps indicative of a lowered startle threshold toward novelty. As such, aversive procedures used in the training of working dogs may promote strong one-person bonds and facilitate a desire to please via an acquired perception of the trainer as enhanced source of social reward and an increased alertness and reactivity for novelty and change consistent with the necessary preemptive readiness and social wariness of working dogs toward strangers.

Ambiguous Social Behavior: A Sign of Stress or an Enhanced Readiness to Submit and Obey?

Instead of instilling social aversion and anxiety as suggested by the authors, the foregoing animal and human research supports the notion that competent electronic training appears to promote positive social attachment, safety, and reward effects that may be provided and amplified via affectionate petting and reassuring praise. The preponderance of scientific evidence suggests that ES escape/avoidance and pain reduction should promote long-term effects that are incompatible with fear and stress, making the trainer an object of significant extrinsic reward that actually enhances the dog's welfare via an improved capacity for social coping, learning, and adaptation. Evidently, many of the shocks delivered by the handlers were far from traumatic experiences for the dogs, since the authors had to double-check with them to confirm the actual number of shocks received by the dogs. The following passage makes clear that the handlers probably used shock in a measured and contingent way that provided the dogs with significant behavioral control:

> The durations of most reactions to shocks were immeasurably short, possibly due to the fact that dogs were asked to obey some command or take some action immediately afterwards. (321)

From the foregoing description, it appears that ES was applied in a manner that met controllability standards, further making the attribution of stress and welfare harm resulting from electronic training seem more like an unfounded accusation than a scientific conclusion. Assuming that the handlers used both momentary and continuous levels of stimulation, the evidence also suggests that the dogs did not respond to longer durations of shock as being particularly painful; that is, the initial "immeasurably" brief reactions appear to indicate startle, a psychological response, but not reactive sequelae indicative of traumatic pain. In any case, for most dogs, the apparent enjoyment derived from the protection-training process itself far exceeds the periodic penalties that occur while learning how to play the "attack game" in accord with appropriate rules. Furthermore, once critical limits and fair-play rules are set via inhibitory conditioning (e.g., all-stop, stop-change, and go/no go), the social and play rewards associ-

ated with the activity itself should exert potent counterconditioning effects, thereby further reducing any secondary aversive emotional conditioning effects arising from inhibitory conditioning with shock. These various bits of circumstantial evidence conflict with the allegations that shock, as used by IPO trainers, promotes social fear, stress, and represents a serious threat of harm to the long-term welfare of trained dogs.

The ambiguous social behaviors that the authors represent as markers of fear and stress have been previously investigated and interpreted differently elsewhere (Beera et al., 1998). In that work, distinctions are drawn between behavioral indicators of fear, stress, and submission evoked by a moderately strong shock in comparison to other sources of startling stimulation. The researchers found that a robust cortisol release was produced by nonsocial fear-eliciting stimuli (e.g., electrical shock and blast of a nautical horn), however, provocative handling and startle (e.g., repeated physical restraint and opening an umbrella) in a social context produced negligible cortisol secretion. Significantly with respect to the behavioral correlations of the present study, they learned that nonsocial aversive stimulation, such as shock, produced a relative absence of oral behaviors (e.g., lip licking and tongue flicking). These previous findings suggest that activation of the HPA system occurs predominantly in response to nonsocial aversive events, whereas aversive stimulation occurring in a social context tends to produce precursor submission behaviors (intention movements) with a relative absence of concomitant biological stress. These findings are consistent with a motivational partition between stressful fear elicited by nonsocial aversive stimuli and submission behaviors evoked by social challenges and threats (startle), perhaps via a modulating effect of person. Whereas the increased oral behaviors and postural changes shown by laboratory dogs were previously interpreted as signifying an increased readiness to submit, these same behaviors now, as exhibited by working dogs toward their handlers, are characterized in an entirely different light, with the present authors now arguing that such oral behaviors and changes in posture and gesture implicate fear and aversion toward the handler as the result of receiving shock in the handler's presence.

A substantial body of prior research has also shown that the critical factor affecting adverse stress and welfare parameters is the relative control that the dog has over the delivery of appetitive and aversive events. Despite this prior work regarding the important linkage established between event uncontrollability and stress, no effort was made by the authors of the present report to sort out the effects of controllable versus uncontrollable ES. Nevertheless, the dogs in the present study appear to adequately learn to control the electrical event, and since there is no significant evidence reported that suggests that the dogs suffered a loss of biological fitness or physical or mental harm due to ES, there is little justification for the use of the term "stress" to describe the present findings, especially so since prior evidence shows that contingent and controllable ES delivered by a radio-controlled collar in the context of dog training produces negligible immediate or lasting biological stress per cardiovascular and HPA-axis markers (Stichnoth, 2002).

If one defines *welfare* as "The state of an individual as regards its attempts to cope with its environment" (Broom and Johnson, 1993:1978), one might even argue that contingent ES probably exerts a long-term beneficial influence on the dog's welfare insofar as it enhances its efforts to acquire an adaptive coping style. Finally, if the behavioral differences attributed to shock in the handler's presence are interpreted in a manner consistent with the observations of Beerda and colleagues (1998), one arrives at an entirely different set of implications. Instead of indicating the presence of stress and fear, the slight lowering of posture, oral behaviors, and increased paw lifting are now viewed as precursor submission behaviors expressed in the context of coping successfully with an aversive social event. Consequently, if one accepts the behavioral changes described by the authors at face value, all that one might fairly conclude is that ES, in the context of obedience and bite work, generally establishes effective

inhibitory control over target behaviors (e.g., bite release) while enhancing the dog's readiness to defer to handler command and control, as indicated by the presence of increased precursor submission behaviors.

In conclusion, contingent ES at the levels normally used in competent dog training is not intrinsically stressful or a threat to a dog's welfare and may be highly beneficial to the extent that it promotes adaptive behavioral change and improved coping skills (see *Stress, Distress, and Potential Adverse Side Effects of Electrical Stimulation*).

Is Physical Traumatization and Manhandling Really Better Than Shock?

The authors appear comfortable with the idea that "beatings and other harsh punishments, such as kicks or choke collar corrections" are somehow preferable to shock, since dogs exposed to such treatment do not show presumptive behavioral signs of stress and lasting fear that they claim occur from brief and contingent ES. Regardless of how one feels about the use of dogs for police and military work or dog training in general, implying that beating or kicking a dog is in some way preferable to brief ES is simply wrongheaded and makes no sense from a training or welfare perspective. Further, placing a slip-collar or prong-collar correction in the same category as beating or kicking a dog reflects a profound lack of knowledge and appreciation of the training process and how such devices are used to achieve training objectives. Many dog trainers on both sides of the e-collar controversy have struggled for decades to refine the training process into the humane and sophisticated art that it has become today, only to have it mandated that manhandling and brutalization are not a significant threat to a dog's welfare. There is no need for complicated statistics to demonstrate adequately that harshly striking a dog can exert potent and lasting adverse social and emotional effects that significantly impair its capacity to function and cope effectively, as amply demonstrated by Solomon and colleagues (1968). Abusive hitting and manhandling can also exert variable long-term developmental impairments of social behavior dependent on individual differences and rearing histories (Fisher, 1955; Freedman, 1958).

Construing that physical abuse might be less of a threat to the welfare of working dogs than is a brief dose of harmless ES is simply bewildering and impossible to take seriously. The notion that dogs might be better off getting choked, beaten, and kicked rather than receiving contingent ES makes absolutely no sense and is contradicted by common practical experience. In dog training, not only is the e-stimulus precisely defined in terms of duration and intensity, it can be delivered and stopped with precision, with very little generalization (if any) to the handler, producing minimal signs of discomfort or subsequent distress to the dog and no sign of physical trauma. ES has the added benefit of hundreds of experimental learning studies involving dogs and other species, providing a comprehensive knowledge base for its use as a training tool. In addition to the slip, prong, and halter collars, a wide range of electronic training devices are recognized by the *Professional Standards for Dog Trainers* (Delta Society, 2001) as effective and humane tools of the trade. Along with radio-controlled electrical and spray collars, bark-activated and containment devices are included in the standard and treated as professional equipment for the control and improvement of dog behavior.

Methodological Concerns and Recommendations

Methodological aspects of the present contribution to the dog welfare literature are disturbing and deserving of further attention. The first of these concerns is the woeful lack of appropriate controls to limit experimenter bias and assumptions concerning the use of aversives in dog training. Neither of the authors openly acknowledge a prejudice or bias for or against electronic training, but the authors clearly bring to the study some established negative beliefs about the subject matter, as evident in the first line of the introduction, where electronic training is lumped together with beatings and other means that cause "wounds, pain and mental harm" (320) to dogs. Later in the text, they also link

"choke collar corrections" with kicking, beating, and other "harsh punishments" (332), raising further concerns about the authors' knowledge and understanding of the dog-training process and the tools used by practical dog trainers. Schilder has previously urged that the *only* legitimate use of an e-collar is for suppressing predatory behavior (sheep killing) (*Applied Ethology Listserve*, September 20, 1996, 07:27:00.30), making the conclusions and recommendations of the present study appear somewhat like a foregone conclusion.

Despite the presence of obvious negative convictions toward dog training in general and electronic training in particular, the researchers took no measures to blind themselves to experimental and control groups, raising reasonable concerns about experimenter bias entering into the data collection process and post hoc treatments, which should necessarily be regarded as tainted and suspect. Further, the experimenters interacted with the trainers in ways that may have influenced them, thereby raising the possibility that a subtle element of participant bias had been introduced into the study. For example, to establish an accurate frequency of shock, they asked trainers how many times they had shocked their dogs. Aside from potentially making the handlers self-conscious about the number of shocks they delivered or, perhaps, causing them to increase or decrease the frequency of stimulation, such questioning may have caused some of them to deliver stronger levels of stimulation than might ordinarily be used in order to make the effects of shock more apparent to the observers. Several other potential participant bias effects might have easily slipped into the experiment as a consequence of handler interrogations regarding the frequency of the independent variable.

Although one might seriously doubt that any group of self-respecting trainers will ever again make themselves available for such a study, one possible way to perform blind and fair studies would be to have all the dogs wear an e-collar or a dummy collar. In addition, the experimenters might remain behind a blind while team assistants make video recordings of relevant training activities for later analysis. Once the training session is over, subsequent observations might then be made without the observers knowing which dogs were exposed to the independent variable. The experimenters manipulating and performing post hoc analyses of the collected data might only be permitted to see tapes and coded information in which the actual moment of stimulation is blocked from view, and an equal amount of video block is yoked to control dogs not receiving stimulation, thereby providing further precautions against bias. If a significant effect consistent with the hypothesis exists, the researchers should be able to identify it through observational and statistical means alone without knowing which dogs actually received the shocks. If correlations between particular behaviors and biological stress are of interest, in addition to observational data, relevant biological data should be collected at critical times before, during, and after the training session. In addition to obtaining salivary samples, temperature and real-time heart-rate measurements should be taken. By collecting various biological data before the e-collar is worn, while it is worn, and after it is removed, potentially significant within-subject effects might be identified and linked to associative learning resulting from ES. With a baseline of such relevant information, meaningful correlations between behavioral signs and biological stress might then be possible to establish. In the absence of biological markers, the attribution of significance to ambiguous or ambivalent behaviors presumed to index harmful stress struggles for footing at every step before collapsing, as it were, for lack of evidence.

Despite numerous variables affecting the quality, quantity, and subjective experience and potential harm of the e-stimulus, the authors make no effort to collect relevant data concerning the intensity or duration of the shock used by the handlers—variables that would significantly enrich the statistical analysis. The independent variable (ES) is treated as a constant of several thousand volts—a relatively meaningless open-circuit measure of electrical potential that is equivalent to the shock produced after scuffing one's feet on a carpet. In general, they treat shock as though any amount were bad, analogous to asserting

that the toxic effect of taking one capsule of phenobarbital is equivalent to taking a full bottle. They repeatedly emphasize that such devices produce stress, but provide no evidence that ES in the context of dog training overtaxes biobehavioral control systems or harms a dog's biological fitness in any way, making the use of the term "stress" seem unwarranted (Broom and Johnson, 1993). The data in the present study are derived from a mean of three shocks of an unknown duration and intensity. To extract the subtle causal relations that the authors attribute to ES from such limited exposure to a vaguely defined electrical event seems a daunting challenge further complicating the process of sorting out cause-and-effect relations between shock and the specific changes in behavior that are attributed to it. Given the demonstrated fortitude and resilience of dogs to hundreds of repeated shocks under laboratory conditions and protocols resembling torture (see *Stress, Traumatic Avoidance, and Laboratory Conditioning with Shock*), it is highly suspicious indeed that working dogs, bred for hardness and drive, would fall victim to lasting harm as the result of receiving three or so shocks during training. If true as reported, the real news in this study is not the effects of ES, but the constitutional weakness of Dutch working dogs. How dogs cope with ES and other forms of aversive stimulation is largely determined by individual differences of a genetic nature and the relative controllability of the events (Corson et al., 1973) (see *Electrical Stimulation Controllability and Safety*).

The authors suggest that a goal of their study was to determine the short-term and long-term effects of shocks, yet they fail to provide any data relevant to the determination of long-term effects. The short-term differences between the two groups in the present study were derived from averaged scores obtained by one-zero sampling at various times relative to some significant interactive event between the dog and handler (e.g., at 1 minute into free walking, they assessed tail, body, and ear positions; and, during obedience exercises, tail and ear positions were graded 3 seconds after the command; whereas other behaviors were graded 10 seconds after the command) and context. One might wonder what the results would have looked like if the sampling occurred after 2 minutes of free walking rather than 1 minute. Also, what would the results look like if a 3-second delay were used to sample target behaviors after the command in the aforementioned situations. For example, dogs stimulated 2 minutes prior to the observation window will likely show very different behavior from dogs stimulated 30 minutes prior to observation.

The small sample size, lack of controls for the effects of age (Beerda et al., 2000), interindividual differences and polymorphisms (Van der Berg et al., 2003), individual variations affecting stress proneness (see Vincent and Michell, 1996), and possible prior exposure to electrical training make the comparisons between shocked and nonshocked dogs statistically weak. Although the authors made some effort to match the shocked and nonshocked groups roughly in terms of breed and sex, controlling for the effects of age was completely neglected. This is not a minor point, because Beerda and colleagues (2000) had previously shown that socially ambiguous (nonspecific) displacement behaviors (e.g., increased licking) are strongly correlated with the dog's age. Despite an intimate familiarity with these earlier findings, the authors provide no information concerning the age of the dogs and apparently made no effort to control for this potentially significant source of error. The authors treat the presence of ambiguous social behaviors as an established behavioral index of stress, but, in fact, no such validated stress index exists.

The inventory of behaviors that the authors have identified in the present report as indicators of fear and stress have not been disambiguated under natural conditions, nor have they proven to be very reliable as markers of stress in the context of laboratory investigation. Ogburn and colleagues (1998) found that dogs wearing halters that clamp around the nose showed marked postural and behavioral differences (e.g., lowered head and ears back) indicative of fear and subordination in comparison to dogs wearing flat collars, who appeared more excited and difficult to control. Dogs restrained by halters also engaged

in significantly more biting at and fighting against the leash and exhibited a higher level of pawing. While wearing a halter, dogs appeared to avoid looking at the handler during obedience training, suggesting an adverse motivational effect on social engagement not present in the case of dogs wearing a strap collar. Despite these relatively robust postural and behavior changes indicative of distress, physiological testing for sympathetic arousal and markers of stress showed no significant difference between dogs wearing halters and dogs wearing flat collars. The tests performed included measurement of blood pressure and heart rate, respiration rates, and pupillary dilation, as well as ACTH and cortisol levels. These prior findings significantly conflict with the notion that such behaviors are markers of stress that represent a serious threat to a dog's welfare. Further, Beerda and colleagues (2000) have explicitly warned against the use nonspecific displacement behaviors for indexing stress. This previous work acknowledged a danger of misinterpretation when one draws conclusions regarding stress from the presence of ambiguous social behaviors, giving rise to a curious violation of the law of noncontradiction: "Because stress behavior is rather variable and often nonspecific to stress, it is readily misinterpreted" (60). The foregoing is a muddled proposition. A collection or set of behaviors cannot be logically classified as simultaneously belonging to and not belonging to the defining category or class. Insofar as *stress* is not functionally present in some instance of behavior, that particular instance is not an example of *stress behavior* but a behavior with functional characteristics exemplifying another class. The hypothetical set consisting of behaviors classified as *nonspecific* to stress with respect to the class of behaviors such that stress is a defining characteristic would necessarily be an empty one. Although a behavior may belong to more than one class or category, insofar as it possesses complex functional or descriptive characteristics appropriate to the inclusion and exclusion criteria of each classification (e.g., both offensive and defensive aggression are types of aggressive behavior), claiming that the behavior in question is nonspecific (that is, it simultaneously belongs and yet does not belong to one or the other category) would necessitate a third category (e.g., panic aggression). Finally, there are experimentally established ways for developing behavioral and physiological indices of stress, fear, and pain (see Broom and Johnson, 1993) that should be performed and rigorously validated before they are experimentally applied and used to justify a call for intrusive legislation. Traumatized puppies and dogs appear to show lowered startle thresholds and intensified startle responses, making tests evaluating prestimulation and poststimulation startle parameters a potentially useful index for evaluating the short-term effects of fear. Startle tests might also provide useful means for evaluating long-term fear effects in combination with physiological indicators of an impaired capacity to cope adaptively.

To increase the likelihood of extracting viable correlations from their data, the authors excluded behaviors that occurred in less than 50% of the dogs. While such a method might help to increase the likelihood of getting results, such post hoc manipulations also significantly reduce statistical power. Further, how can one be sure that this selection process is performed in evenhandedly? One obvious problem with the procedure is that certain traits that may have contributed to the selection of those dogs receiving electronic training might be confounded with the behavioral effects of ES. As a result, those common predisposing traits and behaviors exhibited by dogs receiving electronic training might be statistically amplified and mistakenly identified as representing between-group differences resulting from ES. For purposes of controlling these confounding variables, a baseline of within-subject data sets for the dogs receiving ES would need to be assembled prior to the exposure. A within-subject design (each dog serving as its own control) might help to avoid many of the aforementioned pitfalls. Such within-subject data collected for the experimental and control groups might be subsequently used to make more reliable between-subject comparisons between shocked and nonshocked dogs than allowed by the Schilder and Van der Borg design.

Alternatively, a larger sample might help to reduce some of the confounding effects resulting from individual differences and other uncontrolled sources of error.

The performance of multiple between-group comparisons in the absence of appropriate corrections for type 1 error is another troubling feature of the study. Type 1 error occurs when a statistically significant result is obtained due to chance. Repeated tests and comparisons can artificially cause the probability (*p*) value of some results to reach significance, just as flipping a coin enough times will eventually produce three heads in row. Consequently, to control the error rate associated with multiple comparisons, appropriate statistical precautions are taken, including the use of corrective procedures to avoid false positives. Without such corrections, there is a risk of turning up apparently significant results that do not actually exist. The more that statistical data are churned by multiple tests and comparisons, the greater is the risk that spurious results will be mistaken as significant differences. Despite an obvious potential for error favorable to their central hypothesis, the authors nevertheless rejected the need for a correction method because such treatment would likely cause much of what they held significant to vanish. The Bonferroni method was explicitly rejected, and the authors opted to publish their results in an uncorrected form to preserve the appearance of credible significance. Experimental findings that lack sufficient statistical strength to withstand appropriate corrections to prevent false positives are viewed with justifiable suspicion.

Implications

The authors grant that only small behavioral differences between the shocked and non-shocked dogs were found, yet they show little restraint or reserve in the way they interpret and amplify the significance of these slight differences with anecdotes and speculation. Even the title betrays a misleading implication with respect to the study's significance since the study design a priori lacks the capacity to make any meaningful determinations about the effects of shock received during training on the long-term welfare of dogs. Of course, the authors acknowledge that long-term harm cannot be extrapolated from their findings but then go on anyhow to assert that such significance nevertheless somehow does exist: "We have not proved that the long-term welfare of the shocked dogs is hampered, but we have made clear that it is under serious threat" (332). It is bewildering to consider how one might justify the claim that a causal relation exists, such that P gives rise to a serious threat of harm to Q, without first demonstrating that P can actually harm Q—otherwise the assertion that P represents a serious threat of harm to Q does not make any sense. On the other hand, though, if one already knows that P represents an increased risk of harm to Q, how can one state that a causal relation of harm between P and Q has not been established, such that given the occurrence of P then Q is threatened with future harm. Lastly, if, as established by the first part of the authors' foregoing statement, the long-term welfare of a dog after exposure to shock is regarded as undetermined, then P could just as easily have a long-term beneficial effect on Q or possibly exert no measurable effect at all with respect to harm or benefit to Q. Since a causal relation has not been established between an exposure to shock and long-term adverse effects, one can only conclude that biased assumptions and beliefs led the authors to the speculation that shock is stressful and represents a serious threat to a dog's welfare. Even allowing that brief shock might momentarily produce changes in behavior consistent with pain and fear, obviously a specter of *post hoc ergo propter hoc* ("after this therefore because of this") looms over the speculation that the transitory effects of ES might represent a serious threat to a dog's long-term welfare—speculation that has no legitimate place in a scientific work of this nature. Finally, in the absence of consistent operational (descriptive and functional) definitions of stress and welfare, applied impartially, these notions will rapidly degenerate into shifting (and therefore increasingly meaningless) concepts of convenience for

those wishing to impose their personal beliefs and preferences on others with respect to animal care and training.

Many of the negative statements and claims made by the authors conflict with prior evidence that they neglect to consider, stating that "no systematic investigations regarding possible long-term effects of the use of the collar have been published" (320). In fact, the available prior work provides behavioral and biological evidence that contradicts the allegation that contingent shock delivered by a radio-controlled collar is likely to promote long-term harm to a dog's welfare. Stichnoth (2002), for example, concluded, "If the dog is able to foresee and avoid the shock due to direct association with an object nearly no increase of salivary cortisol can be measured during the shock test and no increase four weeks later" (182). A similar lack of long-term adverse side effects has been reported in shock used to suppress predatory behavior (Christiansen et al., 2001a and b) and to control avoidance-motivated aggression (Tortora, 1982). Consequently, the authors of the present report have not proven that ES in the context of dog training poses a serious threat or any other harmful influence with respect to a dog's immediate or future fitness or adaptability (welfare). The assertion that shock used in the context of dog training poses a serious threat to a dog's welfare should be considered unfounded, at least until significant contrary evidence is made available.

Arndt and Bartko (2003) explore some of the ethical implications of intentionally failing to take appropriate measures to prevent false positives when performing behavioral studies involving multiple tests and comparisons:

> Since an underestimation of Type I error rates can lead to false impressions and treatment practices, this issue is of serious concern. While it may be comforting to speculate that follow-up studies will fail to replicate the spurious finding—hence eventually set the record straight—this attitude is becoming an increasingly shallow reassurance. All too often the popular press takes note of positive findings and reports them. Once the results are touted in the news, the public's knowledge about them is seldom corrected since follow-up negative studies are not deemed newsworthy. This not only is misleading it also unfavorably affects scientific credibility. Furthermore, the rapidity of information transfer effectively removes the "waiting period" safeguards that science once enjoyed. In times past, there was a slow, cautious progression from when scientific results appeared in journals to when the findings surfaced in popular practice. Given rapid publication, electronic publishing, and the Internet, this safeguard is vanishing.

The obvious dangers underscored by the foregoing passage are not without relevance to animal welfare research. Already in February 2003, results prefiguring the findings of the present study (published in March 2004) were presented before the British Parliament, representing the lone bit of scientific evidence given in support of banning the manufacture, sale, and use of electronic training collars in England:

> A Dutch study by Dr. Joanna Van Der Borg compared dogs trained using electric shock collars with dogs trained using more conventional methods. The shocked dogs showed persistent and long-term behaviour differences that indicated that they were under stress and in fear. (Rendel, 2003:column 870)

It is noteworthy that these claims attributed to the present study (or a related study not cited by the authors) include the assertion that "persistent and long-term behaviour differences" were found to result from the use of ES in dog training—a conclusion that might also be easily taken away from the study by uncritical readers. The danger should be obvious. An opinion, even an erroneous and unfounded one, cloaked under the authority of science carries great potential power to influence public opinion and policy-making decisions. Unfortunately, even after a flawed study is debunked, many diehards will continue to embrace and defend it, making it the meme of the day. Slowly by repetition and political pressure, such "snark bait" may even worm its way into the law, thereby violating the rights of everyone compelled to obey it.

Arbitrarily restricting the manufacture, sale, and use of e-collars or any other training tool recognized by the dog-training profession as standard equipment (see Delta Society, 2001) may violate federal antitrust laws that

guard against unfair infringements on free trade. In any case, such restrictions will not stop abusive behavior. Instead of making a beneficial change in the lives of Dutch working dogs, the most likely long-term consequence of the present effort to ban electronic training devices, should the efforts of Schilder and Van der Borg succeed, will be to increase the practical trainer's reliance on less efficient and potentially more harmful physical procedures, as needed to establish safe control over the working dogs' aggressive propensities and enthusiasm. Only education can hope to improve the way people interact with animals, but the power of education is based on the credibility and quality of the information provided and the integrity of the educator imparting it. Further, the arbitration of controversial welfare issues depends on a balance of science and ethics tempered by common sense and kindness. The key role of science in this process will only succeed to the extent that the scientist is recognized and trusted by all parties as a fair and objective arbiter, free of anthropomorphic emotionalism, private prejudice, malice, and legislative agendas. Legislation and policy changes that adversely impact established professional activities or infringe upon free trade are costly to society and represent a significant hardship to individuals and industries that are forced to bear the brunt of the burden. These sacrifices are part of social progress and human betterment, but they are costs that are onerous and hard to bear when the research used to achieve those ends is flawed. Every time a study published in a peer-reviewed journal contains unproven speculation that harms the interests of a particular group or product with misinformation, no matter how heartfelt the underlying sentiment, the whole scientific community will continue to suffer from the repercussions of mistrust long after the study is forgotten.

ELECTRONIC TRAINING COLLARS IN PERSPECTIVE

Although generally reliable, effective, and humane, electronic training aids have attracted considerable criticism in recent years. Much of the criticism is based on incomplete, biased, or faulty information about the nature of ES and the techniques used to deliver it. Many of the critics of electrical training are strikingly ignorant regarding the use and effect of such tools, viewing them as draconian punishment devices causing significant pain and distress to dogs. Modern electronic training can produce consistent low-level ES or vibrotactile stimulation that causes very little discomfort. Technically, the electrical output of modern e-collars is similar in principle to the ES produced by medical devices used to treat pain. The devices are generally easy to use and perform reliably and very effectively as a minimally aversive means for establishing escape/avoidance control through negative reinforcement. Leading manufacturers of such devices strive to produce radio-controlled training devices that operate effectively at low levels of ES—starting at levels that are barely perceptible to human touch. As the result of sophisticated design and circuitry advances, modern e-collars cannot burn or otherwise damage skin tissue, except as might occur as the result of electrode irritation. Klein (2000) performed a series of tests on various collars in which the electrodes were placed on porcine skin preparations. The highest electrical currents produced by the collars tested were repeatedly applied to the skin for 5 minutes, under both dry and wet conditions. The tests showed conclusively that the electrical current produced by the e-collars tested does not cause burns of any kind. Contemporary devices do not produce significant heat on the skin, even after prolonged and repeated stimulation at the highest levels. Various soft and pliable electrode materials have been developed in recent years that will hopefully help solve skin irritation problems in the future. Disposable conducting rubber or siliconlike caps placed over metal electrodes would potentially help to solve some of these problems.

Despite the relatively harmless and innocuous character of the stimulation delivered by modern electrical training devices, some veterinarians, behaviorists, and animal welfare authorities have alleged that such devices hurt dogs (Frank, 1999), burn the skin (Seksel,

1999), and promote harm to the human-dog bond and welfare of the dog (Schilder and Van der Borg, 2004). Many anti-e-collar campaigns have centered around misinformation supported by veterinary misdiagnoses regarding the capacity of e-collars to produce burns. At least one person has been unfairly prosecuted and convicted on cruelty charges stemming from accusations that a bark-activated collar she used severely burned her dog's neck (Wellington, 1999). In some quarters, there is considerable pressure under way to make the case that e-collars are cruel (Kisko, 2003), with some organizations virtually pleading for anecdotes and hearsay with which to build a case in lieu of a genuine body of scientific evidence. The following, presented before the British Parliament, is an example of the sort of disinformation that governing bodies are spoon fed with the explicit purpose of biasing their decisions and promoting restrictive legislation:

> Other cases include those of dogs that have been brought to vets with severe neck burns. Of course, it is always claimed that such injuries are the result of a malfunction of the collar rather than deliberate mistreatment. One inevitable cause of malfunction is that the electrical properties of an animal's neck are affected by how wet it is. (Rendel, 2003:column 870)

With respect to the first point, to my knowledge no recognized authority has claimed that skin irritation and lesions are the result of burns caused by a malfunction of a collar stimulator. The assertion that electrode lesions are caused by a collar malfunction is a straw-dog argument with no substantive evidence to support it. In fact, no one has ever proven that even the slightest burn can be produced by one of these devices. Of course, a simple series of experiments on an anesthetized dog would rapidly put the matter to rest, perhaps helping to prevent future misinformation, false charges of cruelty, and legal wrangling, such as recently occurred in the Australian federal courts. In that situation, statements made by a senior Australian Royal Society for the Prevention of Cruelty to Animals (RSPCA) inspector asserting that e-collars produced electrical shocks sufficient to cause severe burns prompted an e-collar distributor and a manufacturer to file suit seeking damages and to set the public record straight. The judge decided the case on the merits of testimony given by an electrical engineer retained by the respondents. The expert stated that although the open circuit electrical potential of the collar in question was indeed 2705 V, the actual voltage driving electrical current at the electrode-skin interface was estimated to be on the order of 2 V! As a result, the judge found that the public statements asserting that e-collars inflicted a 3000-V shock were, "in every sense, misleading or deceptive" (Federal Court of Australia, 2002), and decided in favor of the complainants and awarded the e-collar company $100,000 in damages. As previously discussed (see *Electrical Potential, Current, and Power*), the open-circuit voltage produced by these devices is rather meaningless for estimating the size and potential for harm delivered to a dog. The judge in making his ruling found that e-collars are incapable of producing burns (Brine, 2002).

To some extent, the apparent confusion regarding electronic training is due to a lack of working knowledge and experience with electronic training tools. Many critics appear to lump together all forms of ES, regardless of intensity, under the same rubric of an imminent potential for harm and malfeasance. This unscientific and irresponsible practice blurs significant distinctions between the effects of the radio-controlled ES produced by modern e-collars and the effects of traumatic electrical shock, as historically used in the laboratory to induce learned helplessness and traumatic behavioral adjustments, namely, shock capable of doing great physical and psychological harm. It is of utmost importance when discussing shock and ES to specify with some precision the level of stimulation to which one is referring. As noted previously, ES that is virtually imperceptible to human touch can be extremely effective for some dog-training purposes, just as HLES that produces localized and physically harmless pain can be effectively used to rapidly deter highly motivated and undesirable behavior. Electricity, like gravity, has varying degrees of intensity and potential to do biological harm. By way

of illustration, consider the very different effects resulting from the action of dropping a bowling ball on one's foot versus the effects caused by dropping a tennis ball instead. Although gravity mediates both of these actions, the pain and physical damage caused by the bowling ball would obviously be significantly greater than the effects produced by the tennis ball. Although electrical current delivered at high amperage can be life-threatening or produce significant burns, the ES levels most commonly used in dog training are extremely low, often being barely perceptible or producing a mild tingling or pricking sensation to human touch. A dog's experience is probably more akin to an annoying tingle (low level) or startling twitch (moderate level) sensation—not painful shock. Of course, at higher levels, the electrical output of such collars can be both painful and startling, but such stimulation is infrequently used in the context of electronic training.

Modern techniques and devices incorporating LLES are distinguished by the capacity to produce a graded and relatively harmless level of stimulation. Breland-Bailey (1998) has stressed that ES is highly controllable and can be precisely adjusted to meet exacting specifications. She argues that the controllability of ES recommends its use as a laboratory tool as well as a practical means for decreasing undesirable behavior:

> A. The amount of shock can be precisely determined and measured. It can likewise be precisely controlled so as to avoid physical damage and evaluate the amounts needed to achieve certain behavioral effects.
>
> B. This means that a shock need not be the same as hitting a fly with a cement block. It can be as strong or as weak as desired. Some ES can be so weak as to resemble only a slight tingling. Indeed, some human observers even report a mild, pleasant effect.

She then goes on to describe how such stimulation has been used to control self-injurious behavior in autistic and retarded children:

> This kind of electrical stimulation has sometimes been used in controlling self-destructive behavior in autistic and retarded children. It is not so much a punishment for such behavior, because the "shock" is so mild, as it is an alerting of the child that he is beginning to emit such behavior. If he then stops, his subsequent response can lead to positive reinforcement.

This description precisely captures how ES is most effectively applied in dog training.

Although uncontrollable shock and pain may produce significant stress and fear that can interfere with effective learning, the low to medium levels of ES most often used in the context of electronic training produce minimal distress and typically result in very effective, efficient, and lasting behavioral change. Dogs receiving such training usually exhibit very little distress or confusion; to the contrary, most dogs show signs of enhanced relaxation, confidence, and playfulness subsequent to electronic training. This practical observation is supported by many laboratory studies that have shown how escapable ES is followed by opponent emotional relief and relaxation—safety (Denny, 1971 and 1976). Many authors have emphasized the role of pathological anxiety and stress in the etiology of compulsive self-directed licking, but none have actually quantified the alleged presence of anxiety or demonstrated evidence of elevated cortisol secretion or other physiological markers of stress in dogs showing compulsive behavior. Assuming that anxiety and stress are significant factors in the etiology of such problems, and granting for the moment that ES is fear-eliciting and stressful for dogs, one would expect that such stimulation should increase licking behavior. However, as discussed previously, Eckstein and Hart (1996) found that remote ES reduced psychogenic licking significantly in several dogs, with no significant adverse side effects. Similar benefits of radio-controlled and behavior-activated ES have been found in treatment of aggressive behavior and separation-related excesses (see *Separation-related Problems and Punishment* in Chapter 4). Electrical stimulation in the treatment of behavior problems requires that the cynopraxic trainer/therapist possess appropriate technical knowledge and skills together with a sensitive appreciation for potential adverse side effects.

Electronic training has many potential applications in the context of behavior ther-

apy that remain unexplored, largely because of prejudice, misunderstanding of the process, and an exaggeration of the risks posed by electronic behavior therapy and training. An area of considerable interest for future practical application and research is the use of remote-controlled LLES, scentless spray, and vibrotactile stimulation in the context of puppy training, especially with highly impulsive and reactive young dogs showing excessive mouthing, biting, chasing behavior, aggressive tendencies, or social deficits not adequately responsive to food-based conditioning, play training, and conventional directive efforts alone. Although Polsky (1994) has suggested that ES might be used as a standalone modality for inhibiting "incessant" mouthing and biting in puppies, such training would be best applied in the context of appropriate reward-based efforts aimed at integrating excessive competitive behavior into an appropriate play outlet. Electronic training collars used for such purposes should be fitted with appropriate amplitude control (e.g., a voltage divider) to ensure that the ES delivered does not exceed a mild, attention-controlling level (tickle/tingle), even when delivered at the highest level. Early preliminary exposure to LLES may prove highly beneficial for hunting and working dogs, especially when electronic training is likely to figure prominently in adult training activities and fieldwork. The goal of early electronic training is to establish a positive bias toward ES as a controllable deterrent introduced within the context of reward-based training and play.

Aside from an incomplete understanding of the training process and lack of familiarity with electronic training devices, some of the irrational criticisms of ES may stem from phobic emotional and cognitive elaborations. For most people, the first experience they have with electricity is painful shock. Electricity is a common household hazard that parents repeatedly warn or punish young children about not approaching in order to instill fear and avoidance. Consequently, as the result of direct fear-eliciting experiences and fear-instilling parental warnings of the potential harm of electricity, most people are inculcated with a powerful aversion toward ES. The inculcation of negative associations with electricity is further magnified by the extreme images of electroshock therapy and electrocution that further bias people against the biological and psychological effects of ES. Other lasting fallout may stem from the use of electrified floors, belts with studs for the remote delivery of shock to buttocks, and the use of cattle prods to control the self-injurious behavior of institutionalized autistic and retarded children (see Lovaas et al., 1965; Lovaas and Simmons, 1969). In one of these studies (Lovaas and Simmons, 1969), children that banged their heads against walls, struck themselves, or bit into their skin were exposed to a brief (1 second) aversive shock delivered by a battery-powered "inductorium"—a cattle prod. The image of severely retarded children being repeatedly shocked with a cattle prod makes one cringe—the more so when the procedures are described in the emotionless and sterile language of a behaviorist. The emotional controversy provoked by the use of shock to control child behavior may have negatively biased the public's perception regarding the humaneness of ES for training purposes, whether for the control of children or dogs.

Future Prospects and Trends

When properly understood and employed, ES can be effectively used to modify dog behavior without eliciting significant stress or fear. Given the potential benefits of LLES for dog behavior control and the relatively harmless and innocuous nature of LLES, it is nothing short of appalling that so many respected authorities, who otherwise show evidence of intellectual integrity and scientific restraint, have chosen to condemn electronic devices, based on personal prejudice and the hearsay opinions of others. Some outspoken critics appear to lose all perspective and semblance of reasonableness when it comes to electrical training aids, accepting and perpetuating patently emotional and misleading arguments as matters of fact. Individuals who otherwise may strive to shape their opinions and attitudes in concordance with verifiable empirical

evidence betray their lax commitment to scientific method when they pronounce sweeping and unsubstantiated generalizations denouncing electronic training aids as inhumane tools that are used to abuse dogs. The same persons who reject LLES may embrace without question the use of highly intrusive restraint tools (e.g., halters and muzzles) or blast dogs at close quarters with compressed-air nautical horns without blinking. Considering the widespread incidence of dog behavior problems and the questionable efficacy of many current treatment strategies, one would expect greater open-mindedness with respect to tools (electronic and otherwise) that might offer significant and unexpected therapeutic benefits.

The manufacture and distribution of electronic training devices have become big business. Worldwide sales of e-collars for the year 1999 reportedly topped 3,000,000 units in that year alone (Holliday, 2000). Probably many more are sold today, with tens of millions of these devices in current use. In the United States, in particular, a growing number of professional dog trainers and dog behavior consultants have integrated electronic devices into their reward-based training and therapy programs as adjunct tools. Numerous public seminars and workshops are now dedicated entirely to providing the dog-owning public with detailed instruction on how to use electronic training devices effectively to promote desirable behavior and deter undesirable behavior. If a threat of harm existed at a population level, as alleged by critics, one would expect that many more dogs would have behavior problems and physical injuries stemming from the use of such devices, including various behavioral complaints involving fear and stress-related disturbances directly tied to electronic training. In fact, adjustment problems resulting from such devices are extremely rare and, in any case, most frequently found in association with behavior-activated systems, not radio-controlled devices. With respect to harm resulting from remote e-collars, to my knowledge there are no scientific reports that provide any proof of actual harm. Polsky (2000) has identified a possible risk of pain-elicited aggression with containment systems, but otherwise such devices appear to be relatively innocuous in comparison to other factors contributing to the development of behavior problems. There is currently no substantive evidence justifying claims of harm produced by electronic training devices, but there is significant evidence of benefit derived from the proper use of such devices for the control of undesirable dog behavior. Consequently, Scott-Park's (2002) suggestion that "there is little data available to prove either their misuse or positive applications" is only half right; in fact, as discussed throughout this chapter, there is substantial evidence of benefit in a variety of professional dog-training and wildlife applications. With respect to unsupervised owner use of such devices, one preliminary survey of dog owners in Australia indicates only minor adverse effects, primarily related to electrode irritations to the skin, with 97% of the respondents indicating that they were either satisfied or "more than satisfied." Among those respondents indicating that they were more than satisfied, 70% reported that they were "very satisfied" or "absolutely delighted" (Coleman and Murray, 2000).

Although the design and safety of electronic training aids have progressed significantly over the years, much still remains to be done to improve the effectiveness and humaneness of these various products (e.g., standardization of the electrical output of collars). Perhaps the most important area needful of attention is user education. Average dog owners typically lack the necessary training skills and appropriate behavioral knowledge to use remote e-collars effectively and safely to train their dogs. Manufacturers of such devices should make a dedicated effort to develop educational materials and programs, such as videos, interactive CDs, and instructional manuals, providing step-by-step instruction on the operation and use of the devices. Whenever possible, however, inexperienced dog owners should be encouraged to receive hands-on instruction from skilled trainers and other professionals experienced in e-collar use. Providing instructional seminars to retailers, trainers, veterinarians, breeders, and other dog-related professionals would be

a helpful means to disseminate pertinent information widely. Many e-collars are sold over the counter to dog owners with little by way of instruction on how to use them properly to train dogs or control a dog's undesirable behavior. The humane use of electronic training equipment depends on an educated end user; oddly enough, though, few manufactures have come to grips with their responsibility in this regard and, along with pet-supply retailers, appear content with the status quo and the short-term profits derived from the sale of these products to a relatively ignorant dog-owning public—a state of affairs that is difficult to fathom when one considers the high stakes. Eventually, this strategy may prove foolhardy, perhaps leading concerned individuals and organizations critical of such devices to seek legislative action to restrict their sale and use by the public, altogether.

As with any training device or technique capable of producing significant discomfort to dogs, trainers have an obligation to use the least intrusive and aversive means necessary to achieve necessary behavioral change. In addition to eschewing techniques that produce unnecessary distress and pain, trainers should be guided by an overarching spirit of kindness and respect for dogs. Despite such problems and limitations, little doubt exists that electronics in one form or another will significantly influence the future of dog training and dog behavior therapy. Further, as more trainers and behaviorists discover the usefulness of LLES, novel applications and advances for the use of radio-controlled and behavior-activated devices will certainly develop. The potential of training systems incorporating LLES and positive reinforcement to enrich the lives of companion dogs and improve their behavior will be limited only by the creative imagination of progressive trainers and the ingenuity of bioelectrical engineers to make such devices as painless as possible.

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10

Cynopraxis: Theory, Philosophy, and Ethics

PART 1: TRAINING THEORY

WHAT IS CYNOPRAXIS?

The term *cynopraxis* combines the Greek roots cyno (*kunos*) or "dog" and praxis (*prassein*), meaning "to do" or doings with the dog. In accordance with Aristotle's use of the term, the notion of praxis consists of goal-directed action performed in accordance with three criteria: the action is voluntary, regulated by informed and rational choice, and performed as an end in itself (Irwin, 1985). More specifically, these *doings* refer to the collective exchanges and transactions between the trainer, dog, and family aimed at promoting interactive harmony, mutual appreciation, and an improved life experience with the dog. Cynopraxis is a pragmatic process constrained to the complementary goals of enhancing the human-dog bond while improving the dog's quality of life.

CYNOPRAXIC TRAINING THEORY

A successful training theory should possess a number of defining characteristics. The theory should be based on a limited number of processes, explain a wide range of related behavioral phenomena, and generate predictions that are testable by direct observation and experimentation. First and foremost, however, a training theory must successfully account for behavioral organization that simultaneously results in order and increasing variability as the result of experience. In addition, the value of such a theory depends significantly on how well its postulates and predictions connect with the factual and theoretical accounts of related disciplines, especially those already possessing a high degree of scientific veracity and maturity. As a result of such cross-discipline linkages, the explanatory significance of the theory is made more general, convincing, and useful. In particular, a training theory should be consistent with the experimentally established findings of formal learning theory and neurobiology, especially those findings that pertain to the organizing processes that contribute to the learning process. Finally, a cynopraxic training theory must satisfy a set of special requirements peculiar to the cynopraxic process itself to provide an explanatory account for the ability of cynopraxic procedures to facilitate competent social skills and change conducive to mutual appreciation, interactive harmony, and affectionate playfulness. A training theory need not be infallible, but theoretical conjecture and speculation should take a form that admits to the possibility of experimental falsifiability. Cynopraxic training theory appears to meet these basic requirements as well as possessing interesting implications for understanding human behavior and learning. An introductory orientation of the theory is provided in *A Brief Critique of Traditional Learning Theory* in Volume 1, Chapter 7.

BASIC POSTULATES, UNITS, PROCESSES, AND MECHANISMS

Cynopraxic training theory argues that instrumental behavior cannot be studied in isolation from affects, incentives, expectancies, and establishing operations, without losing its functional integrity and significance. On a very basic level, behavior is rewarded or punished as the result of its ability to predict and control the occurrence of

significant motivational events (see *Tolman's Expectancy Theory* in Volume 1, Chapter 7). Reward occurs when an action successfully controls the occurrence of an anticipated resource or threat, whereas punishment occurs when such control efforts fail. According to this viewpoint, successful actions serve to confirm prediction-control expectancies, whereas failed efforts disconfirm them. The success and failure of purposive action result in the evocation of emotional state changes that exert significant modulatory (excitatory and inhibitory) changes on behavior; contrary to the law of effect, however, these state changes affecting arousal, alertness, and action readiness are consequent to the effects of reward and punishment and are not themselves the cause of reward and punishment. Successful control is associated with surprise and increased excitability when the outcomes are better than expected, on the one hand, or comfort and safety and increased calming when the outcome is just as expected. By contrast, failure occurs when purposive action results in worse-than-expected outcomes. Failure is associated with disappointment and conflict between excitation and inhibition (distress) or *loss of comfort*, on the one hand, and increased apprehensiveness of danger and an aversion to risk, heightened vigilance, and a heightened action readiness to flee or hide in response to a *risk to safety*. Accordingly, the emotional effects or *affects* associated with adaptive learning are consequent to the confirmation or disconfirmation of prediction-control expectancies.

Thus, learning by reward and punishment is not simply a matter of confirming or disconfirming expectancies but proceeds in accordance with cognitive, emotional, and behavioral adjustments to discrepancies or *prediction errors* between what a dog expects to occur and what actually occurs as the result of its control efforts. According to this hypothesis, an important aspect of learning is the acquisition of reliable predictive information (knowledge) by testing prediction-control *hypotheses* (Tolman and Brunswik, 1935). Dickinson (1980) nicely summarizes the importance of prediction error and uncertainty for adaptive learning:

> It could be argued that there is something intuitively implausible about the central idea of Mackintosh's theory [see Mackintosh, 1975], the idea that animals learn about an event to the extent that it has been a reliable and good predictor in the past. Certainly an animal should control its behaviour on the basis of the information provided by such reliable predictors. It is far less clear, however, that the learning capacity of an animal should be largely devoted to processing events which in the animal's recent history have been constituents of stable relationships. Rather one might expect the animal to devote most of its processing capacity to analyzing events whose predictive significance is uncertain in an attempt to discover relationships involving these events. (153)

Cynopraxic training theory postulates two primary units of behavioral organization: the control module and the adaptive modal strategy. The *control module* consists of prediction-control expectancy, emotional establishing operation, and a goal-directed action. Prediction-control expectancies and calibrated establishing operations operate through the agency of flexible and purposive actions. When control modules are being integrated, positive and negative error signals encode changes to predictive expectancies and establishing operations that refine future control incentives and efforts. Prediction error also promotes excitatory and inhibitory motivational changes in the directions of increased or decreased approach or increased or decreased withdrawal. The emotional effects of reward (positive prediction error) mobilize active modal strategies (e.g., searching, exploring, and risk taking) whereas affects associated with punishment (negative prediction error) mobilize passive modal strategies (e.g., hesitating, ritualizing, and risk avoiding). Active modal strategies mobilized by the affective responses to positive error signals serve to orient a dog toward the source of reward to prolong contact with the location in order to derive information relevant to the control module. Passive modal strategies mobilized in response to negative prediction error serve to orient a dog away from the source of punishment or to hesitate before acting, again with the purpose of obtaining information relevant to error signals.

Adaptive modal strategies consist of both active and passive aspects mobilized in response to positive and negative prediction error in order to maximize resource benefits against costs and to manage competently the risk associated with unexpected windfalls and setbacks. In combination, control modules and adaptive modal strategies enhance a dog's ability to cope with the uncertainty of unexpected change by orienting and prolonging contact with valuable resources, as well as startling events, while extracting information to improve future control efforts. Many confident dogs engaged in an activity interrupted by a sudden startle will jump back to a safe distance (escape-to-safety response) from where they will often immediately return to the spot and cautiously investigate it to obtain information about the unexpected event. Such dogs respond to startle as an impetus to curiosity and increased exploratory activity, which is a pattern that they also show in response to novelty and attractive surprise.

PREDICTION ERROR AND ADAPTATION

Reward and punishment depend on the relative success or failure of instrumental efforts to anticipate and control motivationally significant events. Consequently, aversive and attractive motivational events share a common function of enhancing canine adaptability and security (comfort and safety) by promoting control incentives and goal-directed efforts, with aversive control efforts aimed at seeking and obtaining safety (relief and relaxation) and attractive control efforts aimed at seeking and obtaining appetitive and tactile gratification (comfort and calming). As such, reward-based training incorporates both aversive and attractive incentives presented and withdrawn in highly predictable and controllable ways. Just as stimuli paired with actions that anticipate the successful control of appetitive events are valenced with attractive significance, so are stimuli paired with actions anticipating the successful avoidance of aversive events (Dinsmoor, 2001); that is, they are both represented as reward signals. In an important sense, competent dog training is reward based regardless of the hedonic valence of the antecedent and consequent motivational stimuli used to activate control incentives and to facilitate behavioral change and control. A balance of controllable attractive and aversive contingencies in the context of social exchange promotes learning conducive to the integration of secure place and social attachments.

Prediction error results in significant alterations affecting social expectancies and mood. The direction of these changes depends on the relative proportion of surprising versus disappointing outcomes produced by control efforts. Dogs producing proportionately more surprises (positive prediction errors) than disappointments (negative prediction errors) tend toward elated mood and a positivity bias—changes reflected in a high level of optimism, confidence, relaxation, and persistence at tasks setting the occasion for prediction errors. Dogs operating under a positivity bias expect to produce positive prediction errors (reward). On the other hand, dogs producing proportionately more disappointment than surprise associated with social exchange tend to show dysthymic mood, irritability, and a negativity bias, as indicated by increased insecurity, anxiety and frustration, and a lack of persistence at tasks setting the occasion for positive prediction errors—dogs affected by a negativity bias expect to produce negative prediction errors (punishment) and conflict when they interact with people.

When properly performed, cynopraxic training provides a foundation of orderly interaction between the owner and the dog that can rapidly enhance mood and alter expectancy bias in the direction of increased optimism. The facilitation of an elated mood and an optimistic expectancy bias provides a valuable preliminary foundation for the implementation of more specific behavior-therapy procedures. In addition to improving an owner's ability to control and manage the dog, the highly predictable and controllable nature of training events helps to improve the dog's attention and impulse-control abilities—executive functions that are centrally involved in the organization of competent behavior.

Behavior resulting in a high degree of verification is relatively free of conflict and stress but lacks the excitement and surprise associated with the production of positive prediction errors. The safe and comfortable (but boring) status quo consisting of highly verified control modules are often put aside by dogs, at least momentarily, for the sake of exploring and experimenting, perhaps in search of unforeseen ways to exploit some resource more thoroughly, possibly discovering new solutions to old problems or taking risks with potentially dangerous situations, all in order to obtain the surprise and delight of producing positive prediction errors (cortical rewards). Reward resulting from better-than-expected outcomes helps to optimize prediction-control efforts. Contingencies of positive prediction error that are associated with adventure and discovery produce powerful incentives, sufficient to risk life and limb. Rather than resting content and enjoying the gratification of reliable and safe contingencies, cortical reward and punishment promote incentives to explore and take risks (active modal strategies), or to wait and minimize risks (passive modal strategies) if risk taking is unlikely to pay off.

Actions resulting in cortical reward cannot continue to produce reward by simply repeatedly producing the same rewarding outcome. Paradoxically, the more effective a response becomes, the less it can produce reward. This notion of reward conflicts substantially with the traditional formulation of the law of effect. In contrast to conventional assumptions, a central function of cortical reward according to cynopraxic training theory is to confirm the prediction-control expectancy while simultaneously producing surprise conducive to the mobilization of active modal strategies (e.g., increased seeking, searching, exploring, and experimenting). These observations point to another corollary of the prediction-error hypothesis: formally speaking, behavior cannot be certain to produce cortical reward; it can only increase the probability that a change will occur to produce surprise or relief. The most effective behaviors for this purpose are adaptive modal strategies, that is, a combination of active and passive modal strategies consisting of searching, exploring, risk taking, hesitating, waiting, and ritualizing. The aleatory nature of prediction error marks behavior in search of reward with a characteristic quality of hopefulness. Hope is the condition of behaving in accordance with uncertain, albeit expected, contingencies of reward (surprise), with hope occasionally being dashed by disappointment (see Mowrer, 1960).

Consequently, the surprise of cortical reward increases alertness and exploratory activity while orienting attention toward the windfall. As a result, the cortical reward does not simply increase the future probability of the reward-producing response but also serves to increase the probability of discovering information relevant to the optimization of the action. In addition to active modal strategies, passive modal strategies (e.g., waiting, begging, and ritualizing) are employed to decrease the likelihood of producing negative prediction errors. Passive modal strategies are especially likely to occur under conditions in which active strategies are more likely to produce negative prediction error than positive prediction error. The evolutionary provision of motivational incentives to activate environmental exploration and experimentation as well as to support waiting and ritualizing under adverse environmental conditions is consistent with the behavioral flexibility needed to optimize adaptability and survival fitness.

Learning by means of knowledge derived from experience and prediction error organizes behavior into a base of highly effective and reliable instrumental responses, routines, and patterns conducive to comfort and safety (order), while at the same time increasing exploration, experimentation, and risk-taking behavior (variability), thus optimizing a dog's ability to engage in competent exchanges with the environment. The advent of behavioral organization shaped by positive prediction error and negative prediction error heralds a sophisticated evolutionary advance that succeeds in organizing behavior toward increasing order while at the same time facilitating behavioral variability.

ADAPTATION, PREDICTION ERROR, AND DISTRESS

According to cynopraxic training theory, adaptive adjustments are organized to cope with the conflict and distress associated with error signals produced in association with the control of attractive and aversive motivational events. Control incentives operate in close association with prediction-control expectancies, calibrated emotional establishing operations, and goal-directed actions to prepare and enable a dog to obtain the full value of anticipated outcomes while managing risk and avoiding harm. The function of control incentives is to establish the value of available outcomes and thereby adjust effort to appropriate motivational levels, to increase or decrease a dog's tolerance for distress (frustration and anxiety), and to determine the amount of risk taking that the reward is worth.

Learning by reward and punishment depends on prediction-control expectancies functioning in close coordination with emotional establishing operations and abolishing operations (see *Instrumental Control Modules and Modal Strategies* in Chapter 1). Calibrated emotional establishing operations serve to modulate (excite or inhibit) control incentives in accordance with prediction error and a variety of cross-associative linkages between the event, action, and the hedonic value of the resulting exchange or *transaction*. These predictive relations are subject to constant revision and refinement in response to positive and negative error signals. The emotional establishing operation consists of specific motivational state changes that undergo continuous refinement in conjunction with the revision of prediction-control expectancies in response to prediction-error signals generated by goal-directed actions. In contrast, abolishing operations oppose the emotional and motivational effects of emotional establishing operations (e.g., fear and hunger) through the active inhibition of the motivational state evoked. According to this hypothesis, the inhibitory effects of abolishing operations serve to counter the emotional excitatory effects of establishing operations, but abolishing operations do not generate new motivational states incompatible with the disconfirmed expectancy. The pure inhibitory functions of abolishing operations point to an origin within the executive prefrontal cortex. For example, in response to an emotional establishing operation mediating fear or appetence, the abolishing operation actively inhibits fear and hunger but without replacing it with feelings of safety and comfort (satiation). The incompatible states of safety and comfort are mediated by emergent alternative emotional establishing operations developing in association with the integration of modified prediction-control expectancies.

The reward and punishment of control modules require that a dog be actively engaged in expectant efforts to control some significant attractive or aversive event. Significant events that simply happen to a dog out of the blue may produce temporary or even permanent conditioned excitatory or inhibitory effects on reactive modal behavior but not necessarily alter the control module. The organization of prediction-control expectancies requires the presence of antecedent signals to activate control incentives and preparatory emotional establishing operations in anticipation of the event in order to engage in efforts to control it. Without predictive signals to activate appropriate prediction-control expectancies and emotional establishing operations to guide changes of behavior at the critical moment, the dog may continue to repeat the same behavior over and over again, as Guthrie (1935) relates in a pertinent story that illustrates this aspect of expectancy learning:

> My own view of the way in which unpleasant or unsatisfactory consequences of action affect learning might be further illustrated by a minor incident in the routine of a certain psychologist. He rented an apartment for the summer with a garage which had a large swinging door. From the top of the door hung a heavy chain. Opening the door hurriedly the first morning the chain swung about slowly and struck a blow on the side of the subject's head, a distinctly painful and "unsatisfactory" event. But this continued to happen each morning for some two weeks. Why the long delay in learning to stand aside?
>
> The answer, I believe, is that the act of opening the door was performed while looking

> at the exterior of the door. The chain struck after the door had opened and the scene changed. Dodging was not conditioned on the sight of the door because a sight of the door had not accompanied flinching from the blow. The flinching movement which occurred as the rear of the car came into view was too late. Only after the bruised ear became a chronic reminder and the incident had been talked about and finally had been told to a visitor on the way to the garage, did caution show itself in time. (1935:159)

To intensify attention and to activate control incentives, many dog-training techniques involve the use of attractive or aversive events presented independently of a dog's ability to control them. As the result of such stimulation, attention is intensified and behavior activated into reactive seeking or fleeing modes. When such events are deliberately presented for the purpose of interrupting ongoing behavior, they are referred to as *diverters* (attractive events) and *disrupters* (aversive events) (see *Diverters and Disrupters* in Volume 1, Chapter 7). Diverters and disrupters are often linked to appetitive or emotional establishing operations and used as occasion-setting events to activate control modules incompatible with the interrupted target activity.

Comparator Processing, Allostasis, and Adaptive Optimization

Adaptive behavior is organized to cope proactively with the uncertainty of change. Anticipated outcomes are rarely exactly as expected but are sometimes slightly or far worse than expected, sometimes partly expected and partly unexpected, sometimes slightly or far better than expected, and sometimes more or less as expected. The sum effect of these outcomes is varied still further by diverse motivational states coincident with the outcomes produced. According to cynopraxic theory, predictive relations and transactions that produce positive and negative prediction errors are part of a reality-constructing process. The comparator processing of prediction error is hypothesized to represent an evolutionary opening out of neuroregulatory systems originally dedicated to track energy gains and losses maintaining physiological balance and homeostasis. The behavioral system includes a capacity to respond to error as alarm and warning signals triggering preparatory responses in anticipation of physical and psychological stressors as well as reward signals in anticipation of relief and comfort. Experiences of autonomic arousal triggered by emotional distress (frustration and anxiety), passive modal strategies organized to reduce loss and risk, and somatic reward (feelings of comfort and safety or security) are closely coordinated with energy conservation and homeostasis. Whereas homeostasis is concerned with the maintenance of physiological conditions within narrow ranges of deviation, allostasis mediates adaptive fitness by means of predictive relations shaped to maintain "stability through change" (Sterling and Eyer, 1988), a concept posited as an important evolutionary development in the way biological systems cope with change in the process of optimizing adaptability.

Adjustments to positive and negative prediction error enables dogs to optimize the extraction of useful predictive relations and patterns while limiting risks incurred as the result opening and exploring new things and places. The resulting *opening out* of experience is comfortable and safe (zona securitas) but sufficiently aleatory and dynamic (zona optimus) to maintain a feed-forward momentum, thus offsetting the adverse effects of internalizing (axipetal) and externalizing (axifugal) load. *Load* refers to a loss of adaptability stemming from a binding up biobehavioral energy into entropic activities that impair a dog's ability to initiate flexible control efforts in accord with prediction-control expectancies and calibrated emotional establishing operations (see *Big Bangs and Black Holes: Extraversion, Introversion, and Disorganizing Load*). Specifically, adaptability refers to the ability of dogs to integrate an expansive coping style (freedom) in the process of developing competent skills and the confidence to use them (power).

Feed-forward comparator processing links many different neural systems together into brainwide attunement networks and nodes

that resonate in response to prediction error and confirmation signals to organize adjustments relevant to adaptive needs (Simonov, 1994). The resulting organization is sufficiently complex and orderly to support energy homeostasis, while sufficiently uncertain and varied to enable dogs to cope flexibly with novelty and unexpected change by means of versatile control modules and adaptive modal strategies conducive to allostasis. A complex network of interconnective nodes links the orbital and medial prefrontal cortex (PFC) to the hypothalamus (Öngür et al., 1998), the head ganglion of the autonomic nervous system, which performs numerous integrative functions associated with autonomic attunement, appetitive and defensive motivation, reproduction, and energy homeostasis. In addition to hypothalamic projections, networks comprising the orbital-medial PFC have strong interconnectivities with the basolateral amygdala, basal ganglia, superior colliculus, hippocampus, the ventral tegmental area, the periaqueductal gray, and brainstem vagal system. Multiple levels of comparator processing work in unison to decipher patterns of significance (reward value) adhering to prediction error and to integrate the information obtained into an expanding interactive space opened and exploited in the process of optimizing adaptive skills. Such a layered comparator processing system is consistent with the notion of a behavioral guidance system comprised of cortical-autonomic attunement nodes that assign motivational significance (arousal, incentive, and hedonic value) to attractive and aversive events, select appropriate goal-directed actions, and mobilize adaptive modal strategies in response to error signals. Thus, sensory input processed for error and significance by frontal and limbic networks is projected to the hypothalamus to modulate complex neuroendocrine and autonomic effector systems. These reciprocal pathways between the cortex, limbic areas, and the hypothalamus give rise to a subjective awareness of emotion and motivational state changes via humoral, visceromotor, and afferent vagal feedback from the body (see Nauta, 1971).

The evolution of the neocortical mantle was probably related to adaptations necessitated by the added metabolic demands of thermoregulation. The increased metabolic costs of sustaining temperature homeostasis were met by a matching increase in the early mammal's ability to procure food and other basic survival resources via predictive information and environmental maps organized by the cortex. Interesting, within the developing embryo, the first part of the neocortex to develop is localized around the mouth, with the remaining development of different cortical areas concentrically building out from this core area (Allman, 2000). An increased capacity for organizing behavior in accord with prediction-control expectancies and calibrated establishing operations is hypothesized to be the result of a revolutionary shift from reactive adjustments to internal and external demands to a more flexible and proactive pattern of *adaptive optimization*. This shift toward the organization of behavior in accordance with prediction error and an increased awareness of internal emotional states is likely a result of evolutionary changes to the mammalian brain organized to cope with the complex demands of social life and the extended care of offspring. Awareness of one's emotional state of arousal is a necessary precondition for the hesitation and proactive adjustments needed to avoid conflict, enabling dogs to wait and delay or to select alternative courses of action. Choosing among alternative courses of action probably traces its origins to a habitual pattern of hesitating and refraining to act immediately in anticipation of social exchange, thereby giving rise to an ability to consider and rehearse various control options in advance of initiating action based on the option that *feels* best (more likely to succeed or safer). The ability to hesitate and choose or wait provides dogs with a strong element of voluntary control over social exchange. By means of *feel*-forward comparator processing, emotional establishing operations are calibrated to meet the anticipated needs of ongoing goal-directed projects and ventures based on affective adjustments to prediction-control expectancies and action-mediated prediction error.

The process is analogous to the operation of a radio. A radio is designed to detect and decode subtle patterns of information encoded into electromagnetic signals that are transmitted at the speed of light through the atmosphere, picked up, separated, and conducted through various feed-forward circuits in the process of decoding, converting, and amplifying electromagnetic information into acoustical signals delivered at a rate and strength to enable the listener to experience a coherent and realistic pattern of acoustical stimulation represented to awareness as crystal clear music. A major difference between a radio system and the adaptive brain system is related to the processing of prediction error. Everything governing the operation of the radio is highly predictable and closed. A radio cannot improve over time but merely wears out. The canine brain is designed to improve senso-effector capacities over time by means of adaptive adjustments in response to prediction error. Accordingly, prediction-error signals are converted into energy/information values (energy gains and losses) and uploaded into feed-forward comparator processors that amplify the energy/error signal, converting it into feed-forward predictive relations having information and hedonic value. These energy/information values are selectively amplified while their significance is being determined and thus reach various cognitive (orienting and attending), emotional (arousal, incentive, and valence), and behavior (action mode) threshold values.

Control efforts result in a transfer of energy, the result of which is to open space and to optimize energy gains and losses via the organization of predictive relations. According to this general hypothesis, the moment-to-moment predictive relations that guide goal-directed efforts result in either better-than-expected or worse-than-expected outcomes (i.e., energy gains and losses relative to energy expenditures). These energy gains and losses are scaled and converted into changes of affective awareness and arousal having motivational relevance for ongoing control efforts. Consequently, the discovery of motivationally significant events while engaged in exploratory exchanges with the environment results in incentive (need) and hedonic (like and dislike) changes that increase autonomic arousal and invigorate attention (awareness) commensurate to energy gains or losses calculated to have resulted from the transaction.

Actions are not dissociable from feed-forward comparator processing but are the voluntary and goal-directed manifestations of such processing; that is, adaptive behavior is a complex energy/information exchange system that includes information collecting, processing, and testing functions. Technically, actions are not separate from experience but exist to mediate experience to acquire knowledge. *Experience* is understood as an active process of signification mediated by behavioral experiment, as in sense of the Latin, *experientia*, “knowledge gained by trial and test.” Actions can shape objects but cannot be shaped into objects. Behavior is an activity in constant change, and only a dead dog “behaves” like an object. As such, behavior lacks an objective nature except as regards the history of effects that it leaves on objects. Behavior can produce knowledge by virtue of exchanges with objects (culture) but cannot be known itself accept as a subjective experience of hedonic value, referred to as *appreciation*. During social exchange, the partner’s behavior is the object of esthetic and empathetic appreciation. Learning in accord with the formation of prediction-control expectancies is conducive to the development of increasing social awareness, appreciation, and competence.

Behavior consists of exchanges and transactions with the environment that open and extend fields of predictive relations into the uncertainty of change by collecting, processing, testing error signals. Thus, goal-directed actions are integrated into a stabilizing matrix of prediction-control expectancies and emotional establishing operations or control modules. The feed-forward comparator processing and amplification of error signals as experiential information mediating adjustment is conserved across distant phyla, ranging from conditioned reflexive adjustments to conscious awareness. The nature of such processing is limited by the complexity of the organism’s nervous system. With every level of comparator processing, the significance of the error

signal is extracted and amplified. During highly significant events, the error signal attains affective significance by its representation to awareness as an experience possessing hedonic value. The comparator process involves a complex interactive system of brainwide networks that cooperatively convert and amplify prediction error into significance, with experiential events of significant value attaining to subjective awareness after reaching threshold values prompting attentive interest or concern. Accordingly, habituated stimuli do not attract attention or evoke emotional arousal rising to awareness because they fail to rise above the preattentive sensory threshold of significance. Dishabituated stimuli are represented to experience as significant events by attaining to the threshold value of error signals prompting attention and interest.

The theory postulates that all categories of experience, including sensation, perception, cognition, emotion, and action, are the result of feed-forward comparator processing that extracts, amplifies, and interprets the value and significance of error signals. Error signals reaching preattentive thresholds (saccades) precede sensory and perceptual thresholds (orienting), sensory and perceptual thresholds precede cognitive thresholds (attention), and thresholds of cognitive significance precede affective thresholds attributing hedonic value (conscious awareness and appreciation). Thus, feed-forward comparator processors and dedicated algorithms convert sensory and cognitive values into affective or hedonic values (likes and dislikes) that in turn vector control incentives (needs) on objects of interest or concern with an intent to control them. The attainment of esthetic and empathetic appreciation represents the highest level of comparator refinement and amplification of error signals reaching thresholds of conscious awareness.

The organization of different predictive relations into a unified system entails that some common scalable and interchangeable factor or constant hold between them. The energy gains and losses resulting from social transaction may be scaled, encoded, and invested with value, as information, emotion (incentive and distress), and hedonics (energy gains and losses experienced as pleasure or displeasure). Accordingly, positive prediction error yielding surprise and elation (energy gain) results in an enhanced state of awareness, whereas outcomes that merely match expectancies are encoded to yield feelings of comfort and safety. As such, both attractive and aversive events have allostatic and autonomic value insofar as they evoke arousal/alertness and activate comfort- or safety-seeking action modes. This hypothesis suggests that sensory and emotional experiences are differentiated in terms of the neural energy expended to represent them as subjective experiences, with excitatory events appearing to require a greater expenditure of energy to represent than inhibitory ones. Whereas excitatory events carry an attractive or aversive valence that generates an increased vigilance and readiness to act, inhibitory events conduce a state of autonomic dearousal (Collet et al., 1999). Finally, there is an optimal level of attractive or aversive arousal that promotes adjustment and reward, stimulation under or over which evokes irrelevant or conflictive responses (Hebb, 1955).

Somatic versus Cortical Reward, Projects and Ventures, and Power Incentives

The integration of prediction-control expectancies, calibrated emotional establishing operations, and actions into control modules gives dogs a significant degree of choice in defining and pursuing goal-directed objectives, referred to as *projects* (riskless) and *ventures* (risky). Although adaptive behavior is responsive to the motivational influences of emotional command systems, according to cynopraxic training theory, autonomic arousal and modal activity evoked by conditioned and unconditioned attractive and aversive motivational stimuli do not directly regulate behavior by means of reinforcement and punishment, but instead motivational events generate control incentives (e.g., hunger, thirst, fear, anger, and loneliness) and distress (frustration and anxiety) in association with excita-

tory and inhibitory state changes that alter alertness and action readiness.

Technically, reward and punishment refers to the relative success or failure of goal-directed projects or ventures to control significant motivational events. Control efforts that match expected outcomes confirm or *reinforce* the control module. Although such matches or somatic rewards may verify control modules, gratify control incentives, promote relaxation, and generate security (comfort and safety), they do not add anything new to a dog's ability to predict or control the event; that is, they do not reduce uncertainty adhering to change. Since the verified action is asymptotic in its capacity to produce reward, verification establishes an increasingly stable plateau of order (see *Reinforcement and the Notion of Probability* in Volume 1, Chapter 7). Verifying events serve to gratify dogs motivationally and to maintain the status quo—a condition of no change and no need to change. Under highly verified and regimented environmental conditions, learning may be significantly impeded by a lack of sufficient prediction error to produce cortical reward. The reduction in reward under such circumstances may produce various deleterious and damaging behavioral effects paradoxically despite a high degree of order and adequate basic resources and safety from danger. For example, a dog may engage in risky sensation-seeking behavior to raise the intensity and variety of stimulation to obtain positive affects from social exchange.

Whereas the confirmation of a control module results in reinforcement (verification), the disconfirmation of a control module results in its rapid or gradual extinction. *Rapid extinction* occurs as the result of the signaled discontinuation of the instrumental control contingency, with the previously rewarded behavior now failing to control the aversive or attractive motivational stimulus. In contrast, *gradual extinction* occurs as the result of an unsignaled discontinuation of the control contingency such that a significant amount of uncertainty remains regarding the status of the contingency. In addition to disappointment and discomfort, the gradual extinction of a control module produces significant anxiety and frustration associated with uncertainty. Avoidance learning is particularly problematic in this regard. An unsignaled discontinuation of an avoidance contingency gives a dog little information about the necessity of the avoidance response. Since the dog cannot know whether the avoidance response is necessary without testing the contingency by withholding the avoidance response, it may continue to perform the response long after it is unnecessary to do so. Consequently, in order to learn the status of the avoidance contingency requires that the dog take risks and test it periodically by withholding the avoidance response or forgetting to respond. In highly aversive or traumatic events, the risks are so great that dogs may persist in the avoidance response indefinitely rather than test the contingency, obtaining significant reward from the safety produced by the strategy. The major difference between rapid and gradual confirmation and disconfirmation of learned behavior is the relative degree of certainty that the dog possesses regarding the status of the control contingency.

Many common behavior problems stem from inconsistent efforts to disconfirm and extinguish social control modules and routines operating in association with intrusive modal strategies (e.g., begging and attention seeking), thereby producing significant positive prediction error and reward when the dog unexpectedly succeeds in compelling the interactive partner to yield more than he or she may wish to give, a disruptive source of reward that serves to increase intrusive limit testing, demanding behavior, and social risk taking. Consequently, the gradual disconfirmation of control modules and routines may provide a problematic backdrop for inadvertent reward, invigorate undesirable modal strategies, generate significant anxiety and frustration associated interactive conflict, and support vicious-circle behavior (i.e., increasing persistence associated with escalating punitive efforts). As a result of these problems, rapid disconfirmation via the signaled discontinuation of the control contingency is usually preferred to gradual extinction, not simply because it is faster acting (a criterion that is

not always consistent with long-term interests), but because it minimizes the risks and side effects associated with inconsistent extinction efforts. Although the disconfirmed instrumental control module is taken out of service, it is not unlearned or removed from storage, and it remains available for future use should it be needed. Alternative control modules are generally trained to replace undesirable behaviors associated with problematic or excessive modal behavior (e.g., attention seeking and begging). In an important sense, cooperation is simply attention-seeking and begging routines refined by training and established rules or control contingencies that set limits on the opportunity to gain the social and appetitive rewards sought by the dog.

When purposive control efforts produce better-than-expected or worse-than-expected outcomes, feed-forward comparator neural processors detect the mismatch and extract energy/information from the error signal. In contrast to the calming and relatively neutral emotional effects of somatic reward, the comparator processing of positive prediction error yields state changes that range from elevated interest and concern to power elation and emotional relief. As the error signal rises to the significance of hedonic value and *cortical reward*, it is encoded into comparator network nodes and engrams that inform prediction-control expectancies and calibrated establishing operations. The revision and optimization of the control module are associated with increased alertness and attention, vectoring reward value on the action and context producing the surprising event while activating adaptive modal strategies.

Neuringer (1969), for example, demonstrated that pigeons and rats would engage in key pecking and lever-pressing actions to earn food, even though the same food was made freely available to them within the experimental chamber (see *Contrafreeloading* in Volume 1, Chapter 5). These findings are consistent with the notion that successful control efforts are valenced with positive hedonic value and that the organization of adaptive behavior by reward does not depend on the satisfaction of needs or the escape/avoidance of danger but instead depends on a hedonic factor derived from the successful control of significant events: "Responding for food, like play and exploring, appears to be a natural part of the behavior of animals and does not necessarily depend upon any prior motivating operation.…the present findings suggest that animals often emit instrumental responses which reduce no biological need and abolish no threat" (401). According to cynopraxic training theory, exchanges yielding positive hedonic value serve to promote active modal strategies (exploring and experimenting), whereas outcomes or exchanges yielding negative hedonic value and increased risk promote passive modal strategies (e.g., hesitating and ritualizing). The differentiation of adaptive modal activity into active and passive strategies in response to positive and negative prediction error promotes behavioral variability, thereby improving a dog's ability to exploit unexpected windfalls while exercising appropriate caution and restraint.

From the perspective of adaptive optimization, reward (power/energy gain) and punishment (power/energy loss or risk) are both viewed as having positive significance insofar as they contribute information that refines a dog's prediction-control efforts. The essential difference between them from an experiential viewpoint is subjective; that is, reward is experienced as a gain having positive hedonic value (pleasure and power elation), whereas punishment is experienced as a loss or risk having a negative hedonic value (displeasure and power deflation). Actions that succeed in establishing effective control over a significant resource acquire positive hedonic value, whereas actions that fail acquire negative hedonic value. A principle difference between the occurrence of unexpected attractive motivational stimuli and cortical rewards yielding hedonic value is *power*. Attractive and novel events that merely happen to a dog may yield significant changes that affect arousal and modal behavior but not yield significant hedonic value. In the absence of purposeful control efforts guided by expectancies and establishing operations, such events will tickle the appetite with desire but not satisfy it. Thus, impulsive and hyperactive dogs are driven to seek novelty and reward relentlessly and recklessly but

cannot be satisfied so long as their control efforts are performed independently of control modules and power incentives. Such intrusive and exploitive dogs (unstable extraverts) epitomize behavioral powerlessness. In contrast, cortical reward and power elation are the result of occasions that anticipate opportunity and the successful optimization of control modules organized to exploit it.

The combined cognitive and hedonic effects of reward and punishment are reflected in autonomic changes affecting mood (lasting tonic effects) and feelings (transient or phasic emotional effects) conducive to selective attention, impulse control, attachments, and power. *Power* is defined as the acquisition of competent social and motor skills and the confidence to use those skills to optimize control over significant attractive and aversive events. As such, power conduces a state of optimism and increased action readiness (voluntary initiative) to practice and develop adaptive skills. Power is tempered by timing (hesitation and delay) and expansion into novel domains through skilful exploration, experimentation, and discovery aimed at maximizing the success of control efforts while minimizing risks and losses. Power is embedded in timely events that open space and invigorate emergent freedom incentives.

The cynopraxic training process enables the human-dog dyad to pursue an enhanced life experience by organizing social exchanges that mediate mutual appreciation and interactive harmony. Interactive harmony depends on the mutual acquisition of power by social partners to engage in social exchanges free of stressful conflict dynamics. Under the combined influence of power and freedom incentives, competent social exchange systematically increases the complexity and hedonic quality of proxemic relations while expanding the range of interactive relations into the living space by means of increasing cooperation and compromise.

Expectancies, Emotion, and Stress

The ability to regulate emotion adaptively depends on the coordinated refinement of prediction-control expectancies and calibrated emotional establishing operations. The discovery of a discrepancy or mismatch between what a dog anticipates and what actually occurs as the result of its action is adaptogenic; that is, both surprise and disappointment prompt adaptive change (see *Autonomic Nervous System-mediated Concomitants of Fear* in Volume 1, Chapter 3). Control modules resulting in worse-than-expected or less-than-expected outcomes (negative prediction error) produce anxiety or frustration in proportion to the degree of the detected discrepancy, whereas better-than-expected outcomes (positive prediction error) produce surprise and power elation. The adaptive anxiety and frustration associated with negative prediction error exert varying levels of inhibitory or excitatory emotional change that mobilize behavioral adjustments via the activation of the behavioral inhibition system (BIS) or the behavioral approach system (BAS). As the match is secured, the evoked frustration and anxiety are reduced in association with relaxation and feelings of comfort and safety. According to this hypothesis, comfort and safety result from adjustments that reduce frustration and anxiety by producing *as expected* outcomes, that is, outcomes that match or verify prediction-control expectancies. Rewards producing comfort and safety promote security and a calming effect in association with passive coping strategies (e.g., hesitating, waiting, and watching) and the avoidance of punishment (i.e., the loss of comfort or safety). The calming effect associated with enhanced comfort and safety appears to be mediated by the parasympathetic branch of the autonomic nervous system (ANS), suggesting the term *somatic reward*. In an important sense, somatic reward serves to mediate adjustments conducive to both behavioral and biological adaptation (homeostasis) via the reduction of error signals generating frustration and anxiety.

The reward associated with positive prediction error mobilizes intrinsically rewarding active modal strategies (e.g., seeking, hunting, and exploring), increased excitement and alertness, and elated mood via the activation of dopaminergic mesocorticolimbic reward

pathways. The surprise associated with better-than-expected outcomes mediates adaptive optimization (order with variety) and is referred to as *cortical reward*, emphasizing its executive organizing, exciting, and mood-enhancing effects. Learning is stressful but less so to the extent that adjustments are gradual and voluntary, based on reliable prediction-control expectancies, and organized in a social environment (home) generally perceived as safe and supportive. The ability to competently organize behavioral output toward the optimization of somatic and cortical rewards while avoiding punishment (loss of comfort and safety) is referred to as an *adaptive coping style*. Dogs showing adaptive coping behavior efficiently select control modules, monitor and assess outcomes, and make appropriate adjustments in accordance with prediction-error discrepancies.

When an established social expectancy is disconfirmed in a dramatic, threatening, and uncontrollable way (loss of trust), a dog's behavior may rapidly fall under the influence of stressogenic emergency arousal (fear or anger) and the activation of species-typical autoprotective coping strategies. Whether the dog confronts the threat, backs down, attacks, or runs away depends on the nature of the provocation, the size of the perceived discrepancy and amount of threatened loss or harm, the strength of elicited aversive arousal (anger or pain), the quality and strength of affiliative buffers (effect of person), protective quality-of-life (QOL) factors, behavioral thresholds controlling flight-or-fight behavior, acquired ability to regulate emotion, outcomes of past agonistic encounters, and so forth. In general, the way dogs respond to social threats and challenges can be divided into five types depending on reactive thresholds (see *Behavioral Thresholds and Aggression* in Volume 2, Chapter 8). Most dogs will cower to the ground and become immobile (high-flight and high-fight thresholds—type 1), others may attempt to run away (low-flight and high-fight threshold—type 2), some may stand their ground and confront the challenge but not attack unless provoked (high-flight and medium-fight threshold—type 3), some may attack without hesitation (high-flight and low-fight threshold—type 4), and a few may respond with panic and rage (low-flight and low-fight threshold—type 5). If a dog's efforts to escape are thwarted, an attack threshold may be rapidly reached, and under the influence of escalating fear and anger, a panicked attack with rage may follow. A dog that is prepared to confront a challenge or threat may hold ground but rapidly attack if reached for or grabbed, and escalate the attack in accordance with the perceived degree of threat. As the result of such agonistic encounters, reactive thresholds may be significantly altered, and the dog may become more reactive under similar future circumstances. Also, after experiencing a disconfirmatory mismatch between expected outcomes and actual outcomes, a dog may exhibit an increased dependence on direct sensory input for assessing the situation, appearing to lose its trust in expectancies for assessing social safety (see *Practical Example* in Volume 1, Chapter 7).

AUTONOMIC AROUSAL, DRIVE, AND ACTION MODES

At a basic level, acting in accord with modal drive is intrinsically gratifying, whether it results in approach and seeking or withdrawal and avoiding behavior; however, thwarting drive behavior is intrinsically annoying regardless of its motivational direction. For example, preventing a dog's flight to safety while operating under the aversive arousal of a threat will likely increase the direction and pressure (control incentives) of its escape efforts with frustration (annoyance). In contrast, behavioral exchanges that result in an unexpected opening to safety while under the added aversive arousal of annoyance may produce a pleasurable surprise consisting of elated relief and an emergent state of relaxation that yields feelings of safety. The reward associated with successful escape to safety promotes the integration of prediction-control expectancies, emotional establishing operations, and avoidance behaviors that lead to safety when exposed to similar future threats and circumstances. Likewise, preventing a hungry dog from taking food placed within its reach is annoying, whereas allowing it to

approach and eat the food is satisfying. Forbidding a dog to approach and eat appears to increase appetitive drive and control incentives via the aversive motivational effects of annoyance (frustration) under the modulatory influence of risk monitoring and anxiety. As the result of increased modal activity and mobilization of control incentives, those behavioral efforts that facilitate access to the food will be strengthened by reward, especially so in the case of novel solutions that the dog discovers as the result of experimenting or struggling under the pressure of distress.

Although the various action modes, drive, and emotional command systems are functionally partitioned, they are not entirely insulated and appear to exert a variety of excitatory and inhibitory influences on one another (see *Emotional Command Systems and Drive Theory* in Chapter 6). In contrast to the relatively strict segregation of quiet and affective attack modes, seeking and fighting modes do not appear to be strictly incompatible (see *Intraspecific State and Trait Aggression* in Chapter 8), whereas social and appetitive seeking and flight modes do show evidence of reciprocal inhibition, as evidenced by the psychogenic anorexia induced by social anxiety. In addition to diagnostic significance, the foregoing observations are of considerable relevance with respect to the benefits and drawback of appetitive counterconditioning as a therapeutic tool for reducing the reactive arousal anticipating certain forms of extrafamilial aggression. Behavioral treatment programs that exclusively rely on appetitive counterconditioning may reduce social anxiety (defense drive) without significantly reducing social anger (fight drive). For example, a mature watchdog when threatening a visitor fully expects that the target will retreat or that the target will fight back. At such times, the dog is attuned with autonomic arousal to engage the visitor in combat—not to make nice—so the presentation of food at such times is entirely out of context. With encouragement, some of these dogs will happily take food from the stranger but still remain in a reactive state of suspicion and suspense. The persistent wariness and readiness of such dogs to attack is only natural when one considers the circumstances and that only a few moments before they were engaged in behavior that established an adversarial relation with the visitor. Actually, the food-giving behavior of the visitor might be interpreted by the dog as a ruse to cause it to lower its guard, thereby making it vulnerable to a surprise attack. As the dog takes food, anxious arousal associated with defensive flight modes may be attenuated, allowing the visitor even to pet the dog without reducing the risk of an attack. The instant the visitor stops feeding or petting the dog or engages in overt actions (stands up) perceived as a threat, the change may trigger a strong catastrophic escalation of aggressive arousal.

When under the heightened arousal of drive compatible with the activation of seeking and prey-catching activities, the opportunity to chase a deer is intrinsically energizing and gratifying for a dog whether the chase succeeds or not, whereas compelling a dog to abstain from chasing a deer is intrinsically annoying. In addition, even though restraint is annoying, it will not help to reduce the future strength of the deer-chasing action mode. Accordingly, mere annoyance is not synonymous with punishment. Annoyance actually may significantly augment arousal and drive while generating more of the predatory action mode by virtue of agitation effects on drive. For example, the use of passive leash restraint (horizontal hanging) to block impulsive control efforts (e.g., seeking, chasing, and fighting) appears to escalate drive significantly by invigorating sympathetic arousal and energizing action modes. The action mode selected is determined by the combined pressure and direction of the motivational event, so that attractive events evoke comfort-seeking incentives and serve to activate approach modes, whereas aversive events are valenced to evoke withdrawal and safety-seeking action modes (escape to safety). A dog may shift from one mode into another under the combined influence of distress (frustration and anxiety) and increased aversive stimulation, thereby recruiting more energetic arousal and effort (escape from danger) with the goal of overcoming the interference blocking the

dog's access or ability to produce a situational change promising to confer comfort or safety.

Efforts aimed at thwarting motivated behavior without first causing a dog to disengage impulsive control efforts are generally unsuccessful. The amplified energetic state changes produced by holding the dog back on leash, for example, are encoded into emotional establishing operations signaling the dog to try harder, thereby increasing the strength of seeking and fighting modes and causing the dog to escalate its efforts when faced with similar circumstances in the future, making the impulsive pattern dominant over other coping options. Forcing a dog to stop an attack risks fanning the fierceness of the attack, just as blocking a dog's escape efforts may cause it to abruptly transition out of the flight mode into a fight mode. Finally, withdrawing social stimulation while a dog is in social drive is intrinsically annoying, whereas providing social attention at such times promotes social attraction and attachment. These are but a few of many linkages between modal activity, autonomic arousal, and drive that impact significantly the efficacy of behavior therapy.

The emotional effects of reward and punishment are closely integrated with the activation and deactivation of relevant drive modes. In addition to the differential effects of attractive and aversive arousal, as reflected in active and passive modal strategies, drive activity can be excited or inhibited by natural triggers or by classically conditioned stimuli. Also, drives can be modulated or interrupted by deliberately educing other drives. Drive deficits and excesses can be manipulated toward equilibrium by educing compatible (excitatory) and incompatible (inhibitory) state changes via the activation of relevant emotional command systems. Teasers are arousal-enhancing tools that are used to tune and boost activity or to attract a dog's attention with repeated lip smacking, clapping, changes of pace, crouching, and sundry other gestures. Drive eduction is often performed by means of diverters and disrupters (generic establishing operations) used to interrupt or balance drive-related activities. A cautionary note here is that stressing excessive reliance on training methods that reduce drive activity by educing incompatible drive (e.g., educing fear to decrease appetitive seeking) may introduce imbalance and destabilize the emotional command system, especially if such stimulation is applied severely or unpredictably or in the absence of stabilizing reward-based training efforts.

Drive and emotional command systems combine to give control incentives direction, pressure, continuity, and momentum, but only actions integrated into control modules are amenable to the effects of reward and punishment. However, reward appears to be more directly related to the hedonic value attributed to transactions rather than the gratification or drive reduction obtained by eating (Young, 1955) or escaping to safety. The actual eating of food and the escape to safety might mediate modal alterations and state changes (relaxation), but such consummatory effects alone may not mediate reward effects. For example, an anticipated food reward that is *bigger* but less savory than expected might actually be represented as a disappointment, whereas a food reward that matches expectations may prevent extinction but fail to support additional learning. Thus, reward appears to be more directly related to the hedonic value of the outcome (Young, 1959) and its capacity to optimize goal-directed efforts than its ability to satisfy a need. Consequently, increasing appetitive drive by food or social deprivation is not typically a very useful way to augment counterconditioning or instrumental control efforts. Alternatively, instead of increasing need (incentive value), a far more valuable effect can be achieved by increasing the hedonic value of the reward (i.e., by use of a more savory food item) or by switching to a different type of reward (novelty) to increase the enjoyment value of the reward object. The manipulation of hedonic value and novelty provides a powerful means to enhance reward value and increase the therapeutic value of food rewards (Zernicki, 1968).

Crespi (1942) showed that the reward value of food can be increased or decreased by changing its size during a post-training test phase relative to the size of the reward used in

the training phase. Initially, Crespi trained three groups of rats to run to a goal box where they received 1, 16, or 256 pellets, respectively. These groups were subsequently tested and compared for motivational differences by giving each of them 16 pellets and then measuring running speed. The experimenter found that rats trained with 16 pellets showed no change in running speed, whereas those that had been originally trained with 1 pellet showed a significant increase (elation effect) in running speed, and those trained with 256 pellets showed a significant decrease (depression effect) in running speed. These findings are consistent with the expectancy hypothesis, whereby a bigger-than-expected outcome (positive prediction error) generates surprise and elation, thereby increasing the hedonic value of the food reward, whereas a smaller-than-expected outcome (negative prediction error) produces disappointment and depression, thereby decreasing the reward's hedonic value.

Actions operating under the guidance of prediction-control expectancies and calibrated emotional establishing operations (control module) are refined or *optimized* by social and environmental transactions that yield surprise or disappointment. Further, the hedonic value of any given transaction is determined by the difference between the gain anticipated from the energy invested in the action and the actual gain produced, less the energetic costs and risks incurred by pursuing the project or venture. Energy is invested in behavioral projects and ventures with an expectation of a profit. Consequently, the optimization of control modules is closely coordinated with an *unconscious* process organized to maximize energy gains while minimizing energy losses and reducing risk. Energy gains and losses are encoded into conscious awareness as pleasurable or displeasurable alterations commensurate to the positive or negative hedonic value of the outcome. Energy gains and losses (i.e., physiological state changes) are scaled or translated into affective state changes that rise to the level of awareness by the amplification error signals provided by feed-forward comparator processing networks that simultaneously construct an experiential engram that informs and modifies the control module. According to this hypothesis, the energy gains and losses inferred from positive and negative prediction error are represented to awareness as affective changes having hedonic significance. These affective changes rise to awareness as substrate neurophysiological alterations are integrated into synaptic elaborations or attunement nodes and nodal networks that alter synaptic sensitivity and mediate long-term reverberation and resonance effects affecting mood and action readiness. The composite synaptic activity of attunement nodes and nodal networks, and corresponding effects on mood and a dog's readiness to initiate voluntary action, are hypothesized to vary depending on the proportion of transactions perceived as resulting in energy gains (positive hedonic value) or losses (negative hedonic value).

The ability of an attractive or aversive motivational incentive to promote instrumental learning depends on its ability to generate sufficient emotional arousal to mobilize an appropriate control module without being so strong that it triggers reactive adjustments. The generation of emotional arousal via the presentation of attractive (appetitive and social) and aversive stimuli varies greatly among dogs. These breed and individual differences reflect the combined influence of genetic predisposition and prior experience on social approach-withdrawal thresholds (social temperament dimensions), coping styles, transient motivational states (e.g., isolation and hunger), survival-mode activity, and autonomic attunement. Dogs combining low-approach and high-withdrawal thresholds consistent with *extraversion* are more likely to persist in conflictive social exchange under the influence of escalating autonomic arousal yielding frustration, whereas dogs expressing high-approach thresholds and low-withdrawal thresholds consistent with introversion are more likely to withdraw from social conflict under the influence escalating arousal yielding anxiety. These tendencies to persist or withdraw in response to conflict exert potent organizing effects on social behavior, mood, and coping styles.

The preference shown by extraverts for signals of reward, novelty, and risk taking predis-

poses them to acquire proactive skills that tend to individuate leader personality traits and roles in association with confidence/playfulness (strong power/freedom incentives), whereas the preference of introverts for signals of loss and risk (harm avoidance) inclines them to express follower and dependency relations in association with greater social insecurity/submissiveness (strong comfort/safety incentives). Ultimately, since most dogs possess both extraverted and introverted traits, the coping styles, social roles, and personality characteristics that they express are highly flexible and tend to shift toward a centrist position under the influence of an adaptive coping style and constructive attunement dynamics. Under the influence of a reactive coping style and misattunement, though, extraversion and introversion become increasing unstable and extreme, with unstable extraverts becoming increasingly exploitive, intrusive, and impulsive, and unstable introverts becoming increasing cautious, withdrawn, and reactive.

PLAY AND DRIVE

Play possesses unique qualities and capacities to mediate rewarding exchange via the activation of a wide assortment of drive-related behaviors educed and liberated from functional significance, including sundry sex-related exploratory activities, seeking and exploratory behavior (object play), social exchanges (flirting, i.e., playful fleeing and fighting), and prey-predator interactions (stalking, chasing, body blocking, and grabbing). Play engenders a sense of empowering confidence that imbues the nervous system and body with a tonic balance of vigor and euphoric feelings of well-being or joy. Play is suspected to promote significant adaptogenic influences over critical neuropeptide and neurotransmitter systems that mediate autonomic attunement and antistress functions (see *Play and Autonomic Attunement* in Chapter 8).

As a specialized modal activity, play allows dogs to access various drive and motor programs and arousal systems but without activating the emotional command and hypothalamic effector systems that normally motivate these drives in earnest. The sum of the foregoing characteristics and neurobiological evidence suggests that play is probably integrated into a far-reaching network of neuronal pathways and attunement nodes that are orchestrated at an executive level (Vanderschuren et al., 1997). A reasonable candidate site of executive control is the dorsolateral PFC, a cortical area that appears to mediate the organization of proactive coping strategies in response to conflict. Some interesting work with juvenile rats has found that 30 minutes of rough-and-tumble play elevates brain-derived neurotrophic factor (BDNF) transcription in the dorsolateral frontal cortex and the amygdala (Gordon et al., 2003). This finding supports the idea that repeated play bouts may exert profound neurodevelopmental effects on executive function and lasting epigenetic influences on a dog's ability to cope with conflict (see *Cortical and Subcortical Comparator Functions and Adaptation*).

A prefrontal localization is consistent with the diverse anticonflict and attunement capacities that play appears to coordinate via an active appreciation of the attentional and emotional state of the play partner (see Horowitz, 2002). To sustain playful interaction, dogs must learn to limit exploitive excesses and to avoid causing play partners pain or fear. These various demands encourage dogs to play fairly and to reciprocally adjust to the play partner's needs, thereby promoting empathy for the sake of harmonious exchange. The distinctive reward features of play probably depend on play partners possessing the ability to regulate play exchanges in accord with a principle of fairness (see *Fair Play, Emergent Social Codes, and Cynopraxis* in Chapter 8). The autonomic and behavioral flexibility of play is likely to contribute an increased confidence and tolerance for unexpected social events. Play arousal is antagonistic to most aversive emotional states, providing a natural antidote against social anxiety, irritability/intolerance, and depression. During cynopraxic training, control modules and routines are brought under the modal control of play incentives. The harmony and fluid rhythms of play exchange are consistent with the integration of autonomic

attunement nodes that promote increasing attraction, attachment, and confidence as social familiarity and play skills develop. Play behavior appears to attune people and dogs to sustained cooperative exchange. The invigorated mutual attention and social engagement, harmonious modal shifting, choreographed proxemics, and mutual appreciation and joy give play exchanges an interactive form and beauty.

Fair Play and the Golden Rule

There is an inherent unfairness in the relative freedom of a trainer and a dog to initiate purposive exchanges and to control the dispensation of rewards—a disparity that requires a novel cynopraxic solution whereby the trainer's advantage is subordinated to the adaptive interests of the dog. Cynopraxic bond and life-experience imperatives are achieved in various ways, but ultimately all training and therapy activities are subordinated to enhancing a dog's ability to engage others in competent social exchange conducive to affection, play, and trust. People and dogs naturally derive significant hedonic value from play and tend to form lasting attachments as the result of social exchanges that entice and sustain playful interaction. Play is incompatible with social aversion, mistrust, and QOL deficiencies, while helping to promote social competence, confidence, and trust; in short, play is the expressive actualization of power. Play activities help to shape optimistic expectancies and improve a dog's ability to cope proactively with social uncertainty. In situations where playfulness is lacking, cynopraxic counseling and therapy efforts are energetically focused on enlivening playful dynamics between the family and the dog, placing the highest priority on enabling the family and the dog to engage in safe play. Working under the assumption that the most important reason to keep dogs is to enjoy their companionship, cynopraxic therapy and training canalize affectionate playfulness toward the attainment of interactive harmony, mutual appreciation, and joy. Regardless of a trainer's orientation, the training process is only truly humane and meaningful to the extent that it succeeds in establishing an affectionate and playful coexistence.

The prohibitions against competitive play that are frequently espoused in the popular dog literature are tailor-made to promote problems. The notion that play (e.g., tug games and roughhousing) promotes aggression is extremely misleading and destructive. In fact, play appears to enhance a dog's ability to cope proactively with conflict situations and unexpected changes that might otherwise result in more serious reactive contests. Players take and give advantage to optimize the reward intrinsic to play. To sustain such play activities, they must be sensitive to one another's needs and play fairly. In the process, dogs learn the *golden rule*: do as one wishes done in return. The leader is not distinguished by possessive irritability and a short-fuse temper that flares into rage at any provocation. A leader's status is measured by the amount of power and freedom he or she has to integrate playful exchanges with others—a prerequisite for integrating cohort relationships, guiding cooperative projects, and performing successful courtship rituals.

Dogs with good play skills exemplify the golden rule in the active and careful way they avoid violating the social code around the rights of first possession, apparently with some expectation that other dogs do the same in turn (see *Fair Play, Emergent Social Codes, and Cynopraxis* in Chapter 8). The code is respected regardless of the other dog's ability or willingness to defend the object in its possession. Leader-type dogs will even refuse direct countermands prompting them to take objects in violation of the code. When in possession of a valued object, however, these same dogs defend the code by a variety of strategies, often by stiffening over the object, which is an action that might also be interpreted in terms of the golden algorithm; that is, the stiffening may be intended to cause the other to hesitate or stop. If necessary, an expression of default dominance consisting of a startling growl-bark or fang whack may be used to defend the code, often followed by the dog shifting away with the object or taking it off to another location. Of course, such

dogs can deliver a vigorous defense against persistent intruders, if need be. A similar pattern of code-regulated behavior and default dominance may be shown around food and other highly valued resources, thereby exercising significant control over conflict-related tensions. The increased willingness of dogs to share valued objects and toys with people probably stems from the greater likelihood of people giving things to the dogs. Again, following the golden rule, giving to a dog is reciprocated by increased tolerance and capacity for sharing by the dog, perhaps fostering human-dog codes and attunement dynamics around shared comfort objects and resources that reduce the risk of conflict. In contrast, people that do not give but instead take, deprive, restrain, and threaten dogs may mobilize a pattern of exploitive and autoprotective dynamics in those dogs. The golden rule provides a useful social algorithm for guiding exchanges conducive to sharing, attuning dogs toward fair exchange and helping to decipher intent guiding canine social behavior.

For the average dog, the benefits of play for mediating social harmony and mutual enjoyment far outweigh any risks incurred by the activity. The common dire warnings and prohibitions against inhibitory training, tug games, and other social play activities often have the effect of *self-fulfilling prophecies*. By following the prohibitions against play, the very problems that an owner sought to avoid are actually facilitated. Many new dog owners hoping to calm an excitable puppy or reduce excessive mouthing or biting fall headlong for this idea. These sorts of arbitrary rules and prohibitions usually need to be imposed on other family members with considerable pressure, since the style of interaction required of them will likely feel stymied and unnatural, perhaps causing them to gradually withdraw their interest from the newcomer altogether. The loss of playful exchange is a tremendous sacrifice for everyone. Puppies and dogs appear to be attuned to play as a way to enjoy and become familiar with people and other dogs. The failure to engage in social play essentially denies a dog access to the interaction needed to integrate the relations required to become a full member of the household.

Note: The normal partition preventing play fighting and competition, roughhousing, and tug games from escalating into aggression in earnest may breakdown in certain dogs, especially certain fighting and guard-type breeds. Such dogs may be preemptively biased to respond to increased competitive arousal and excitement by shifting from a play mode into an attack mode. These dogs can be extremely dangerous for naive people to handle. In addition, nervous and reactive dogs can be dangerous when efforts are made to provoke them into play.

NEURAL COMPARATOR SYSTEMS

Preattentive Sensory Processing

Adaptive orienting behavior is mediated by spontaneous and search eye movements in response to auditory and visual stimuli. Spontaneous saccadic eye movements turn the visual apparatus toward the source of stimulus change in anticipation of an orienting response. These reflexive eye movements help to maintain a audiovisual interface with the immediate surroundings, enabling dogs to represent and map significant changes taking place in the immediate surroundings. Saccadic eye movements are associated with the target-arc response that precedes an orienting response. The target-arc response and saccadic eye movements are functionally associated with a complex network of interconnections between the PFC, superior colliculus (SC), limbic system, and brainstem. The encoding and representation of multimodal input into oculocentric sensory maps at the level of the SC has many implications for understanding how rapid adjustments to sudden change and novelty are perceived and integrated into adaptive and reactive preparatory adjustments. In addition to providing an audiovisual spatial representation mapping encoded sensory input, the SC via interconnectivity with cortical and limbic processing is intimately involved in expectant and preemptive processing of an emotional nature that affects how novelty and change are interpreted. The

detection and processing of change having potential significance appears to be mediated by preattentive interconnectivity between the SC, amygdala, PFC, basal ganglia, and brainstem, which rapidly process incoming sensory information. As a result, sensory processing may acquire a preemptive significance or lack thereof depending on a dog's history of exposure to aversive and attractive motivational events (Carretie et al., 2001; Ikeda and Hikosaka, 2003). As such, the emotional significance of reward and punishment appears to have a far-reaching influence on the preattentive and preemptive organization of perception, cognition, mood, and modal activity. For example, reward-mediated interconnectivity between the SC, PFC, and basal ganglia appears to bias orienting responses in a positive direction, whereas aversive emotional experiences activating preattentive networks between the SC, PFC, amygdala appears to promote a negativity bias (anticipatory anxiety) toward novelty and unexpected events (uncertainty). In addition, the SC may encode template information relevant to the detection of species-typical threats and has direct access to defensive centers organized at the level of the central nucleus of the amygdala, hypothalamus, periaqueductal gray (PAG), and basal ganglia that generates automatic and rapid-onset fear modules at the earliest stage of sensory processing and gating (see Öhman and Mineka, 2001).

The relative ability of an unexpected event to produce an orienting response depends on its conspicuousness, its phylogenetic significance, or its relevance to an ongoing project or venture. The detection of an inconsistency or mismatch in the flow of sensory data is cross-associated with the concurrent sensory input from other modalities contributing to the content of sensory maps represented at the level of the SC (e.g., sight, hearing, touch, and balance). The coordinated processing of preattentive sensory information deemed significant is tagged with hedonic value, resulting in appropriate emotional and autonomic arousal to promote attentional focus or intensification, as needed to guide adaptive actions. On the other hand, sensory events that are sufficiently conspicuous or salient to prompt an orienting response but lack relevance with respect to control incentives are gradually gated out by habituation and ignored by means of active inhibition associated with selective attention. In addition, the repeated exposure to a highly salient stimulus that attracts attention but without significant consequence will cause the stimulus to merge gradually into the background and prevent future associations from forming via latent inhibition (Dess and Overmier, 1989). Latent inhibition appears to cause dogs to actively ignore the event via inhibitory processing at the level of the PFC and SC, a stimulus biasing influence in the direction of irrelevance that must be unlearned for it to form significating associations that are relevant to a dog's control interests. If such a stimulus is repeatedly paired with some significant future event, it will gradually acquire prediction-control significance; however, the associative link between the two events may be more readily dissolved if the contingency between the events is discontinued than would be the case if the stimulus had never been previously presented independently of significance. Similarly, stimuli acquiring attractive or aversive significance resist change or conversion in the direction of an opposite hedonic valence or accepting new associative linkages with events of contrary motivational significance. Conditioned aversive and attractive stimuli acquired in association with first impressions at an early age may leave relatively permanent positive or negative biases that can be rapidly reinstated and guide behavioral output despite intensive counterconditioning or extinction efforts. Exposure and habituation to a broad assortment of uneventful environmental stimuli may reduce the risk of undesirable positive and negative biases that contribute to inappropriate appetites and aversive reactivity later in life via the shielding effects of latent inhibition.

Detecting and Processing Prediction Error

Neurobiological research indicates that reward, motivation, and mood are strongly modulated by mesolimbic and mesocortical

dopamine (DA) activity. Dopamine neurons located in the ventral tegmental area (VTA) show an increased firing rate when putative rewards occur unexpectedly or when such events exceed a dog's expectations. In contrast, DA neuron activity remains unchanged when an anticipated event matches a dog's expectations; when an anticipated event is less than expected or omitted, however, the firing rate is decreased (Schultz, 1998; Schultz and Dickinson, 2000). The VTA projects to the nucleus accumbens and forms a network of connectivity with the PFC, the amygdala, and various subcortical networks that perform comparator and valuative functions that enable dogs to interpret the motivational significance of novel and anticipated events and to adjust behavior accordingly, with cholinergic neurotransmission likely playing a prominent modulatory role (see Miranda et al., 2000; Giovannini et al., 2001; Kobayashi and Isa, 2002; McIntyre et al., 2003; Wu et al., 2004). The expectancy-comparator model proposes that prediction-control expectancies, calibrated establishing operations, and goal-directed actions are organized into control-expectancy modules and adaptive modal strategies. Control-expectancy modules and modal strategies are shaped by positive and negative prediction error into adaptive adjustments with the goal of optimizing instrumental control over significant motivational events (see *Prediction and Control Expectancies* in Chapter 1).

In the case of classical conditioning, when prediction mismatches occur, error signals mediate the recalibration of emotional establishing operations by selectively exciting or inhibiting relevant emotional command systems (valuative modulation), thereby increasing or decreasing motivational incentives and adjusting arousal to match the behavioral needs of the situation. Hypothetically, when control-expectancy mismatches occur, error signals are relayed along comparator loops and interconnecting pathways that mediate valuative changes coordinated with the recalibration of emotional establishing operations, thereby refining the control-expectancy module and modulating state arousal and action readiness to reflect the new information.

Prominent neural substrates and circuits hypothesized to perform this information-integrating process include plastic networks between the following:

Basolateral amygdala: a central hub coordinating the evaluation and attribution of emotional significance to novel and conditioned attractive and aversive motivational stimuli

Bed nucleus of the stria terminalis (BSNT): an extension of amygdala playing an important role in the mediation of seeking incentives, emotion, and vigilance

Ventral tegmental area (VTA): the source of the mesocortical DA pathway projecting to the PFC and activated by the central amygdala in response to psychological stressors

Nucleus accumbens: the mesolimbic DA reward area that plays a significant role in the coordination of incentive and hedonic value attributed to the gain and loss of reward objects

Pedunoculopontine tegmental nucleus (PPTN): the origin of cholinergic neurons responsive to prediction error/novelty and serving to modulate mesolimbic DA neurons mediating reward

Superior colliculus (SC): organizes multimodal sensory maps of the surroundings and orienting response

Lateral hypothalamus: contains hypocretin/orexin cells that promote arousal and alertness via complex interactions with cortical and limbic reward networks, autonomic effector systems, and feed-forward programming of serotonin and norepinephrine release associated with waking states

Basal forebrain: the origin of cholinergic networks modulating awareness and attentional response, hesitation, and increased exploratory activity in response to novelty and surprise

The PFC and the anterior cingulate area coordinate activity in these various limbic and subcortical systems while promoting selective attention and impulse control and organizing flexible control-expectancy modules and rou-

tines (see Schoenbaum and Setlow, 2001; Cardinal et al., 2002).

Attention, Impulse Control, and Processing Prediction Error

The executive selective attention and impulse-control functions of the PFC are largely dedicated to inhibition, but the PFC also mediates excitatory processing related to cortical reward via glutaminergic pathways, including excitatory input from the amygdala, information relevant to conditioned reinforcement in association with the control of aversive and attractive motivational incentives. Prefrontal and amygdalar-glutaminergic pathways also project to the nucleus accumbens and the VTA, areas of the brain that are strongly involved in mediation of reward (see *Prediction and Control Expectancies* in Chapter 1). Among the inhibitory effects of the PFC, the gating out of irrelevant or insignificant stimuli, as described in the previous section, are critical functions necessary to promote selective attention. In addition to selective attention, the PFC narrows response possibilities down to a single best bet based on ongoing control incentives, prediction-control expectancies, and emotional establishing operations. The PFC inhibits actions that are unlikely to succeed and disinhibits actions that are more likely to succeed, while contributing to the activation of active modal strategies via the surprise associated with outcomes. As such, the PFC appears to modulate behavioral output and emotional arousal through the exertion of tonic inhibition and phasic inhibition or disinhibition and the excitatory influence of reward. When instrumental behavior results in outcomes that are better than expected, the mismatch or *positive prediction error* results in phasic disinhibition and elation via excitatory inputs and outputs to reward centers. Conversely, if the behavior produces outcomes worse than expected, the mismatch or *negative prediction error* results in phasic inhibition and disappointment. When functioning under optimal conditions, tonic disinhibition promotes calming and mood states conducive to comfort and safety via the cumulative effects of somatic reward, whereas phasic disinhibition and excitation result in cortical reward and increased exploratory activity and inquisitiveness (active modal strategies), and phasic and tonic inhibition results in hesitation and delay (passive modal strategies). Under adverse conditions, excessive cortical inhibition may cause numerous disturbances of affect, motivation, and attention (hypervigilance) associated with inescapable loss and risk—disturbances that affect voluntary initiative. Disturbances affecting excitatory prefrontal reward systems or loss of appropriate inhibitory and disinhibitory modulation of reward-related behavior may play a significant role in the expression of exploitive novelty-seeking behavior and impulsivity, on the one hand, or incompetent power-seeking behavior, on the other (Van Erp and Miczek, 2000).

An important goal of cynopraxic therapy is to restore functional executive capacity to selective attention and impulse-control functions and to enliven spontaneity and playfulness—the result of a harmonious balance of somatic reward and cortical reward. A foundation of inhibitory control afforded by basic training provides an indispensable anchor for controlling reactive adjustments via the modulatory effects of prediction-control expectancies and provides reactive dogs with the autoregulation necessary to integrate an adaptive coping style and a repertoire of effective behavior. Establishing a reliable repertoire of basic modules and routines (e.g., formal heeling and automatic sit, controlled walking and quick sit, slack-leash walking, and reliable sit-stay and down-stay) is of tremendous value, both as a platform for behavior modification and for the intrinsic calming effects and enhanced social attraction that such training produces.

Cortical and Subcortical Comparator Functions and Adaptation

The selective attention and impulse control mediated and refined by goal-oriented prediction-control expectancies and emotional establishing operations are organized at the level of the PFC; in particular, orbital and medial PFC networks appear to play a crucial

role in governing control-expectancy modules and modulating shifts in attention and motivational direction (Öngür and Price, 2000), as needed to maintain purposive focus and to optimize control efforts (see *Cortical and Subcortical Comparator Functions and Adaptation*). Cortical reward and elation induced by the detection of positive prediction error serve to mobilize active modal strategies vectored on the search for additional opportunity. Reward arousal appears to be constrained by opponent processing, whereby the energy used to represent and experience reward is countered by an opposing *antireward* that restores homeostasis. Conflict monitoring and the detection of negative prediction error also set limits on reward-seeking activities. The anterior cingulate cortex (ACC) is hypothesized to play a key role in the monitoring and encoding of error signals (conflict) occurring in the context of instrumental projects and ventures. Conflict monitoring may be an important way for dogs to obtain control-relevant information not otherwise available. The detection of negative prediction error by the ACC results in motor inhibition and increased activity at the level of the dorsolateral PFC (DLPFC), where refinements to the control module may be integrated (MacDonald et al., 2000; Kerns et al., 2004). Consequently, in addition to monitoring control expectancies for action error or conflict, the ACC probably plays a central role in the mediation of passive modal strategies organized to minimize risk and loss (i.e., calculated hesitation, ritualization, and avoidance).

The conflict-monitoring and inhibitory functions performed by the ACC appear to divert executive attention to error (Luks et al., 2002), perhaps with the goal of "training" the executive PFC, as the egocentric object of emotional pain and distress, to avoid future similar adjustments to conflict. Conflict avoidance is likely a central contribution of the PFC to the integration of an adaptive coping style. In addition, the DLPFC appears to mediate an active interface that anticipates interactive conflict and selects response options that serve to resolve conflict proactively (Badre and Wagner, 2004). With the integration of reliable control modules, ACC error and conflict signals should decrease as executive attention and impulse-control capacities become increasingly competent (see Milham et al., 2003). In contrast to the proactive skills exhibited by dogs operating in accord with an adaptive coping style, reactive dogs treat attractive and aversive motivational stimuli in a highly impulsive manner. The pattern of reactive behavior shown by such dogs depends on their individual differences and specific motivational incentives, variably involving intrusive exploitation, despotic control efforts, social avoidance, or reactive inhibition (helplessness). These cognitive and behavioral changes are consistent with the nervous, exploitative, and autoprotective behaviors shown as the result of a *reactive coping style*.

The ACC is also a locus of interest with respect to the etiology of compulsive behaviors (Ursu et al., 2003; Van Veen and Carter, 2002). Whereas the PFC appears normally to integrate response error and conflict-related information in the process of modifying the control module, in the case of compulsive behavior the diversion of attentional resources for conflict monitoring may become dysfunctional, operating with a high degree of autonomy from the executive refinement of control modules. The increased conflict monitoring and behavioral inhibition mediated by the ACC may impair a dog's ability to vary behavior in response to executive adjustment signals. Whereas increased ACC activity appears to promote compulsive behavior, decreased ACC activity may facilitate impulsive behavior and inappropriate explosive adjustments in response to threats or challenges perceived to lack controllability. The ACC is also nicely positioned to monitor subcortical emotional signals arising in association with conflict (i.e., anxiety, frustration, resentment, worry, and despair) and increased autonomic arousal (Eisenberger et al., 2003). As such, the ACC appears to play a prominent role in the mediation of the reactive coping style emerging within the introversion dimension associated with persistent social ambivalence and entrapment dynamics. In contrast to the central role of the ACC for monitoring and coping with social conflict

and aversive state changes (emotional pain) mediated by autonomic state changes (Thayer and Lane, 2000), the DLPFC appears to actively counteract and prevent aversive state changes associated with social ambivalence and distress (Badre and Wagner, 2004) by heading off conflict by means of fair exchange, compromise, and cooperation. Decreased activity in the PFC may significantly impair a dog's capacity to maintain the flexible interface of autonomic attunement needed to regulate preparatory arousal in support of nonconflictive exchange.

Phylogenetic Survival Modes

According to cynopraxic theory, the cognitive and motivational changes occurring in response to conditions of plenty (favorable) and activity success versus conditions of adversity (unfavorable) and activity failure appear to mediate the expression of different phylogenetic survival modes (PSMs). In general, favorable conditions promote a coordinated *modal phase shift* consisting of cognitive and motivational changes conducive to social extraversion, power, expansion, elation, and well-being, whereas unfavorable conditions result in a coordinated cognitive and motivational shift in an opposite direction conducive to social withdrawal, inhibition and passivity, anxiety, irritability, intolerance, and autoprotective reactivity. Adaptation to persistent stressors may alter a dog's ability to shift flexibly in or out of modes. An inability to produce modal shifts conducive to autonomic attunement may occur as the result of the accumulated physiological and state changes or *allostatic load* acquired in the process of coping with chronic stressors that gradually impede rather than support adaptation (see *Survival Modes and Allostasis* in Chapter 8).

Survival Modes and Adaptation

PSMs exert overarching influences on the emergence of adaptive and maladaptive behavior by shifting motivational pressures, preferences, and priorities. Evidence for the existence of a switch activating PSMs in response to changing environmental conditions and metabolic pressures has been observed in the sedentary and nomadic behavior of male nonterritorial tree lizards (Knapp et al., 2003). Unlike aggressive counterparts who remain true to a territory, nonterritorial males are variably site-faithful or nomadic rovers, depending on environmental conditions. During harsh years of reduced rainfall the nonterritorial males tend to rove, whereas during more favorable years of increased rainfall they tend to stay put. Both male territorial and nonterritorial tree lizards show increased corticosterone levels during harsh years, but only nonterritorial males exhibit reduced testosterone levels. These two behavioral phenotypes appear to be differentiated by a polymorphism that includes a stress-sensitive switch that toggles on PSMs that affect aggression levels, territoriality, and reproductive tactics. During unfavorable years, elevated corticosterone levels and reduced testosterone appear to combine to toggle on a dispersal mode facilitating nomadic roving. However, during more favorable years in which corticosterone levels are low and testosterone high, the modal switch toggles on a sedentary mode conducive to site-faithful behavior.

Among laboratory rodents, the loss of control associated with restraint stress (defeat) or exposure to situations perceived as unfamiliar has been shown to affect agonistic and affiliative thresholds differentially in male and female rats. Female rats exposed to a single 30-minute period of restraint stress show little change in aggressive behavior when tested 24 hours later (Albonetti and Farabollini, 1995). However, if this same strain is exposed to novelty or novelty with restraint stress, the rats show significant change in both agonistic and affiliative behavior. Exposure to novelty alone appears to reduce agonistic behavior selectively while leaving affiliative behavior and allogrooming unaffected, whereas novelty plus restraint simultaneously increases both social agonism and affiliative behavior. The simultaneous activation of both agonistic and affiliative modes may reflect a general increase in autonomic arousal resulting in increased behavioral output in an effort to cope with chang-

ing (novel) social and environmental circumstances, improving the rat's ability to compete, on the one hand, and to engage in conciliatory behaviors, on the other. Interestingly, a factor analysis revealed that exposure to novelty alone not only decreased the frequency of aggressive behavior but also modified the way it was organized. Whereas controls showed two distinct factors partitioning offensive and defensive aggression, the rats exposed to novelty showed only one factor, suggesting that reactive thresholds controlling active and passive defensive reactions had been significantly altered by exposure to the treatment, perhaps enabling stressed rats to cope more effectively with environmental uncertainty.

Evidence consistent with survival-mode hypothesis has been reported in dogs and monkeys (see *Diet Change and the Integrate-or-Disperse Hypothesis* in Chapter 7). In the case of dogs, upgrading to a high-quality diet containing increased levels of fat and protein may either have a calming effect or increase reactivity toward novelty, depending on the presence or absence of social enrichment. Hennessy and colleagues (2002) found that dogs fed enhanced diets showed fewer signs of reactive arousal in response to novelty and startle, but only if they also received supplemental social interaction and training. Dogs receiving the fat- and protein-enhanced diet without social enrichment showed an opposite trend toward increased signs of anxious arousal. Two other groups of dogs were fed a diet containing significantly less fat and protein with and without social enrichment. In contrast to the beneficial effects of increased social interaction and training in the case of dogs fed the enhanced diet, dogs fed the diet containing less fat and protein showed more signs of anxious arousal in comparison to dogs not receiving social enrichment. Among cynomolgus macaques, Kaplan and colleagues (1996) showed that monkeys fed a high-fat diet were less aggressive and showed more affiliative behavior than monkeys fed a low-fat diet—changes linked to reduced serotonin turnover (Kaplan et al., 1994) (see *Fat, Cholesterol, Fatty Acids, and Impulsive Aggression* in Chapter 7).

Survival Modes, Neuropeptides, and Heterochrony

A comparison of genes expressed in the brain tissue of wolves, coyotes, and dogs has revealed that the most substantial genetic differences between domestic dogs and related wild canids are localized within the canine hypothalamus, with a high proportion of hypothalamic genes having been downregulated (Saetre et al., 2004). The study also found that gene expression in the frontal lobes reflected anticipated evolutionary distances, with dogs and wolves showing a closer genetic relatedness than exhibited by the coyotes to either. The third area examined, the amygdala, also showed some interspecific genetic variation, but clearly the hypothalamus appears to have undergone the most significant evolutionary remodeling as the result of domestication. In addition, several peptide systems have undergone significant change, including neuropeptide Y (NPY) and calcitonin-related polypeptide B, both playing important roles in energy homeostasis and appetitive behavior. NPY neurons are localized in the arcuate nucleus of the hypothalamus from where NPY fibers project widely to different areas of the brain. The hypothalamus regulates basic biological (e.g., energy homeostasis) and motivational functions and plays a key role in the coordinated release of numerous bioregulatory peptides in response to adaptive pressures. These ancient peptide systems bridge the brain-body gap, playing profoundly influential roles in the physiological processes associated with metabolism, thermogenesis and thermal regulation, visceral functions, growth, and reproductive activities.

In comparison to wolves and coyotes, dogs show a downregulation of the neuropeptide in the hypothalamus and an upregulation of NPY receptors expressed in the amygdala. NPY receptors in the basolateral nucleus of the amygdala appear to exert potent anxiolytic and antistress effects by dampening the activity of co-localized corticotropin-releasing factor (CRF) receptors (Sajdk et al., 2004). NPY has also been shown to regulate the release of oxytocin and vasopressin by the posterior pituitary (Sheikh et al., 1998), as well as exert modulatory effects on hypothalamic-pitu-

itary-adrenal (HPA) activity in dogs (Inoue et al., 1989; Miura et al., 1992). During sympathetic arousal, NPY release appears to mediate a pronounced inhibition of vagal tone by binding to acetylcholine receptors expressed on parasympathetic nerve endings (Rios et al., 1996). In addition to modulating stress reactions, NPY interacts with orexin to promote feeding behavior. Orexin is a neuropeptide believed to play a prominent role in energy homeostasis and alertness. Low levels of circulating leptin, a peptide produced by adipose cells that monitor energy reserves, stimulate NPY neurons to increase feeding behavior (Jéquier, 2002), while at the same time resetting the hypothalamic-pituitary-thyroid (HPT) axis in the direction of energy conservation and hypothyroidism (Fekete et al., 2001 and 2002). Circulating leptin levels vary in response to fasting and dietary state. Whereas NPY neurons are inhibited by high levels of circulating leptin, orexin neurons originating in the lateral hypothalamus project dense fibers to the arcuate nucleus that may stimulate NPY neurons to increase food intake independently of leptin signaling (Willie et al., 2001), perhaps suggesting a role of hedonic value dissociated from appetitive drive need.

The lateral hypothalamus receives strong projections from the orbitofrontal cortex (OFC), a prefrontal area believed to attribute hedonic value to food rewards (Rolls, 2000) and tactile stimulation. In addition to connectivity with the alertness-promoting cholinergic neurons of the basal forebrain, the lateral hypothalamus projects to the ventrolateral periaqueductal gray (vlPAG) (Öngür and Price, 2000), where it drives parasympathetic adjustments. The effector capacity of orexin and the wide distribution and interconnectivity of orexin receptors in key areas of the brain associated with reward, alertness, and energy homoeostasis (see Willie et al., 2001) suggest that the neuropeptide may play a pivotal role in scaling prediction error in terms of energy gain or loss as well as modulating arousal shifts in response to novelty and the subjective experience of reward. For example, orexin cells stimulate the dorsal raphe nucleus and the locus coeruleus via a feed-forward mechanism involving glutamatergic interneurons modulating the release of both serotonin (5-hydroxytryptamine or 5-HT) and norepinephrine (NE), which, in turn, exert an inhibitory feedback effect over orexin neurons (Li et al., 2002). The interconnectivity between the lateral hypothalamus and the orbitofrontal cortex and reward systems is consistent with the possibility that orexin stimulation of NPY neurons may play a role in sustaining modal seeking activity in response to goal-directed appetitive transactions yielding hedonic value.

The interconnectivity between the OFC, the lateral hypothalamus, and the vlPAG is also interesting with respect to canine narcolepsy, a disorder caused by a mutation of the hypocretin (orexin) receptor 2 gene (Lin et al., 1999). When excited by food or play, narcoleptic dogs are prone to cataleptic attacks stemming from deficit orexin neurotransmission (Fujiki et al., 2002). A network between the lateral hypothalamus, the dorsal raphe nucleus, and vlPAG may play a prominent role in this disorder, especially since the activation of the vlPAG results in tonic immobilization.

The upregulation of NPY receptors in the amygdala and the downregulation of the hypothalamus, as indicated by the finding of Saetre and colleagues (2004), are compatible with a reduced vulnerability for reactive arousal in response to social stressors, a functional change consistent with the differentiation of enhanced abilities to cope with stressful conflict situations. According to this hypothesis, corticohypothalamic nodes and networks interact reciprocally with various hypothalamic effector neurons to modulate allostatic drive and motivational state changes via direct enervation of sympathetic and parasympathetic ganglia as well as by releasing numerous peripheral hormones and neuroendocrine substances within the brain to coordinate metabolic changes conducive to attunement and energy homeostasis. In the wake of increasingly complex social relations and extended care/attachment relations associated with domestication, cortical executive networks appear to have evolved enhanced capacities to integrate sensory and motor

functions with hypothalamic effector systems to regulate drive functions in the direction of increasing sociability and tameness, bringing autonomic and metabolic processes under the enhanced efficiency and unification of centralized prediction-control mechanisms, enabling dogs to respond proactively in anticipation of events and thereby promoting adaptive optimization through social exchange.

In addition to reducing the excitability of hypothalamic effector neurons mediating flight-or-fight reactions, the reduction in predatory behavior by genetic alterations in limbic and hypothalamic nuclei governing prey-seeking drives (see Arons and Shoemaker, 1992) would have likely freed up enormous energy reserves, normally dedicated to the pursuit of predatory priorities, that perhaps turned to the pursuit of social and object play as a compensatory outlet or cooperative hunting for sport. Selection pressures for reduced predatory behavior and increased playfulness would probably have been a high priority with respect to adaptations enabling early dogs to interact safely with children. Similarly, the sexual pair bonding and extended parental behavior that wolves show toward their offspring are reduced in most dogs. Instead, dogs appear to sublimate pair bonding and parental caregiving into what Perin (1981) has described as "superabundant love," combining the sociosexual drives of the wolf mother and father into the playful affection and innocent attentiveness that transforms dogs into supernormal attachment objects (see *Supernormal Attachment Hypothesis* in Volume 2, Chapter 4). The various autonomic and interactive dimensions opened by the downregulation of hypothalamic effector systems mediating predatory and reactive behavior infuse the human-dog relationship with extraordinary capacity for social complexity and adaptability. The downregulation of hypothalamic effector mechanisms mediating flight-or-fight reactions in response to social approach should reduce the flight distance while simultaneously increasing social attraction, thereby elevating fear and aggression thresholds while lowering approach/exploratory thresholds. These behavioral changes are consistent with improved capacities for social engagement, increased tolerance for novelty, and reduced stress reactivity.

Physiological and behavioral support for this hypothesis has been reported among silver foxes selected for reduced fear and aggression toward humans. Foxes showing tameability and increased exploratory behavior have a significant reduction in plasma cortisol levels in comparison to reactive farm-bred counterparts (Trut, 2001). In additon to decreased HPA-axis tone, foxes selected for increased tameability show higher 5-HT levels in the midbrain and hypothalamus (Popova et al., 1991), suggesting that increased 5-HT levels may play a role in the inhibition of defensive behavior. Problematically, with respect to applying the fox model of domestication to dogs, the cortisol levels of wolf pups and adults do not vary appreciably from the baseline cortisol levels of dogs (Seal et al., 1975 and 1987). Further, among free-living wolves, there is no detectable correlation between cortisol levels and high rates of aggression and agonistic exchange (Sands and Creel, 2004). These findings appear at odds with those reported previously by McLeod and colleagues (1996), who described a significant correlation between glucocorticoid levels and rates of aggressive exchange between wolves. Sands and Creel suggest that a significant factor that may explain the heightened stress reactivity shown by captive wolves is related to the vulnerability of subordinates to unavoidable and severe attacks that are more common among captive wolf populations than among free-living groups. Finally, cortisol levels do not significantly differ between reactive and nonreactive dogs, until these two types of responders are exposed to fear-eliciting events and situations (Hydbring-Sandberg et al., 2004).

Other authors have emphasized the importance of the HPT axis and the hypothalamic-pituitary-gonadal (HPG) axis as playing a critical role in regulating developmental and physiological rates modulating neuronal excitation and inhibition. The extensive experimental work by Anderson (1941) and James (1941) was largely dedicated to investigating

the effects of thyroid hormone on the differentiation of behavioral and morphological types among dogs. They argued that temperament dimensions affecting relative excitability and adaptability might be driven by metabolic differences stemming from the level or quality of thyroid or pituitary secretion. They believed, for example, that the physical form, excitability, high activity levels, and alert typology of German shepherds was probably a reflection of an increased responsiveness to thyroid activity, whereas the physical morphology and behavior of basset hounds reflected a slowing physiological rate and reduced responsiveness and ability to acquire conditioned reflexes. To compare the effects of thyroid on behavior and development, numerous classical conditioning experiments were performed on German shepherd and basset hound crosses. The researchers found that they could alter the relative excitability of these intermediate types toward the hyperexcitability of German shepherds by altering thyroid and epinephrine levels, whereas ablation of the thyroid glands, gonads, and adrenal glands resulted in changes in the direction of the inhibited phenotype. These findings are consistent with heterochrony mediating the differentiation of breeds, whereby certain canine developmental rates are accelerated, resulting in peromorphosis (the German shepherd typology), whereas others are slowed down and result in paedomorphosis (the basset hound typology).

Dogs do appear to express individual differences with respect to the production and utilization of thyroid hormone. For example, a comparison of five breeds (beagle, sheltie, cocker spaniel, wirehaired fox terrier, and the basenji) showed that the basenji uses thyroxin at a higher rate than European breeds (Nunez et al., 1970). Whereas the basenji showed a mean thyroidal half-life of 3.3 days, dogs of a European ancestry showed a mean thyroidal half-life of 7 to 10 days. The monoestrous basenji is adapted to an equatorial environment and exhibits an annual breeding cycle timed to occur with the decreasing daylight that occurs around September or October (Scott et al., 1959), whereas the wolf is adapted to temperate climates and programmed to initiate reproductive activity as daylight increases in January or February. Nunez and colleagues speculate that the changes to the reproductive cycles of the basenji may be the result of a genetic alteration in thyroid functions. Among wolves, the reproductive cycle reportedly varies with latitude, occurring earlier in the year at lower latitudes (Seal et al., 1987). Interestingly, Cape hunting dogs shift the timing of reproductive cycles a full 6 months when moved from Southern Africa to Ireland (reported by Seal et al., 1987). In contrast to the basenji, the reproductive cycle of European breeds appears to operate in relative independence to seasonal light periods and the endocrine control mediated by the pineal gland. Dogs that are housed together with other dogs or that come into contact with wolves reportedly show evidence of synchronizing their estrus cycles with the estrus cycles of other females (Harrington and Asa, 2003); further, dogs are kept in close proximity with wolves appear to show evidence of increased reproductive photoperiodicity, coming into estrus in January–February and then again in August–September (Kreeger, 2003).

Hiestand (1989) has speculated that the previously discussed research of James and Anderson suggests the possibility that the neoteny hypothesized to distinguish dogs from wolves (see *Paedomorphosis* in Volume 1, Chapter 1) may be due to genetic alterations affecting the sensitivity of different dog breeds to the effects thyroid hormones—speculation consistent with the notion that early domestication may have resulted in significant changes affecting the pulsatile release and turnover of thyroid (Crockford, 2002). The pulsatile secretion of thyroid-releasing hormone (TRH) by the hypothalamus acts on the anterior pituitary to produce thyroid-stimulating hormone (TSH) and the release of thyroid into the bloodstream (Kooistra et al., 2000). Given the negative-feedback effects of circulating thyroid hormones on TRH and TSH activity, increased episodic production of TRH would likely promote hypothyroidism and elevated prolactin levels (Kaufman et al., 1985), a change in thyroid function consistent with the neoteny hypothesis.

However, somewhat problematic for the neoteny hypothesis are the results of chemistry studies of blood taken from wild-caught wolf pups (4 to 7 months) indicating that young wolves show a tendency toward lower thyroid (T4) concentrations in comparison to dogs (beagles) (Seal et al., 1975). Similar trends toward hypothyroidism have been shown in adult wolves. The thyroid levels of wolves undergo seasonal changes, with thyroxin (T4) levels increasing in the winter and decreasing in the summer (Seal et al., 1987).

Dogs appear to express varying degrees and types of developmental rate changes consistent with dissociated heterochrony. According to this hypothesis, dog breeds are not more or less neotenous but rather show evidence of selective developmental changes that delay (paedomorphosis) or accelerate (peromorphosis) the organization of various behavioral and physiological systems. Alterations in thyroid activity at different prenatal and postnatal periods may yield altered sensitivities to thyroid and mediate functional and morphological changes to the canine phenotype.

Strong evidence indicates that developmental changes in thyroid levels regulate the timing of the metamorphosis of tadpoles into frogs (Bentley, 1976). Evidence of similar thyroid-mediated effects on developmental rates among mammals is less secure, but some well-controlled investigations do indicate that the timing of developmental markers is altered in response to treatments that increase or decrease thyroid activity during prenatal and postnatal development. Maternal thyroid has been demonstrated to alter the expression of the neuroendocrine-specific protein (NSP) and a gene encoding the Oct-1 transcription factor in the cortex and limbic system of the rat brain (Dowling et al., 2000). NSP is believed to play a critical role in the differentiation of neuronal tissue via the modulatory influence of thyroid hormone. Animals exposed to increased fetal thyroid show lasting focal changes in NSP expression in the hippocampus that is enhanced by adult hypothyroidism, whereas Oct-1 expression in the cortex and hippocampus is suppressed in adulthood. Even relatively slight changes in maternal thyroid levels can lead to lasting changes affecting neural development and learning abilities (Colburn, 2004).

In addition to prenatal effects, neonatal hypothyroidism has been shown to exert profound ontogenetic effects over the regulation of genes that program the development of the brain and sensory abilities, including neuronal differentiation, cell migration, synaptogenesis, dendritic structure, and myelination. Thyroid hormone (T3) or triiodothyronine is instrumentally involved in the postnatal organization of 5-HT neural pathways that regulate the stress management system (see *Antistress Neurobiology, Maternal Care, and Coping Style in Chapter 8*). Alterations of thyroid activity can exert lasting impairments affecting the animal's ability to learn and to adapt (see Thompson and Potter, 2000). Recently, Yilmazer-Hanke and colleagues (2004) have shown that the induction of neonatal hyperthyroidism hastens the opening of eyes as well as producing morphological changes consistent with peromorphism (e.g., snout elongation). In addition, transient hyperthyroidism produced several key changes affecting amygdalar activity that continued into adulthood, including a reduction of CRF neurons in the central nucleus of the amygdala and an increase of NPY neurons in the basolateral complex, while increasing the density of tyrosine-hydrolase-positive fibers (indicative of DA transmission). These various amygdalar changes were found to exert various anti-anxiety effects consistent with increased adaptability and tameness. The presence of increased DA activity suggests that part of these changes might be due to sensitization of DA neurons in the VTA, a connection that may play a pivotal role in the process of attributing and updating the hedonic value of motivational stimuli (Baxter and Murray, 2002).

Developmentally, foxes selected for tameness show a steady trend toward increasing exploratory activity and fearlessness in response to novelty, whereas farm-bred foxes become increasingly fearful and inhibited in response to novelty (Belyaev et al., 1984/85). The eyes of tameable fox pups are completely opened sooner than are those of reactive farm-bred counterparts. Also, foxes selected

for tameness show a slightly earlier orienting response to sound. These changes accelerating the opening of the eyes and tendencies toward increased exploratory activity are consistent with the aforementioned effects produced by the administration of thyroid on developmental rates in rats (see Brosvic et al., 2002). Whether these alterations in timing affecting the emergence of fear-related behavior and sensory development among foxes selected for tameness is due to maternal thyroid changes is currently unknown, but the findings do raise a number of interesting questions for future research.

A dissociated heterochrony appears to affect the timing of sensory development and the eruption of teeth among coyotes, wolves, and dogs. Snow (1967), for example, found that coyotes opened their eyes, on average, at day 14, but the milk teeth of coyote pups can already be felt at day 10, 10 days before the canine incisors of dogs can be felt through the gums (Scott and Fuller, 1965). Mech (1970) observed that the front teeth of two wolf pups he raised emerged at day 15, whereas the eyes began to open at day 12 and were wide open by day 15. The developmental dissociation between the eruption of teeth and the opening of eyes in coyotes, wolves, and dogs is consistent with paedomorphosis affecting dentition but not sensory development, with the eyes of dogs opening, on average (with significant breed variation), around day 13 (Scott and Fuller, 1965). The early emergence of reproductive behavior among dogs may reflect an acceleration of developmental rates consistent with peromorphosis, whereas the extended playfulness of dogs may represent a change consistent with a paedomorphic delay affecting social and emotional development.

Since thyroid activity is sensitive to external temperature, with cold temperatures causing an elevation of circulating thyroid (Seal et al., 1987), wolf mothers gestating under cold climate conditions ought to produce more circulating thyroid hormone than mothers gestating under warmer conditions. Given the high degree of fetal responsiveness to maternal thyroid levels, it is reasonable to expect differences resulting from winter gestation and that these differences might affect the adaptability of offspring, with adults showing an increased sensitivity to thyroid levels, causing them to tend toward seasonal hypothyroidism. Hypothyroidism during summer months might enable wolves to conserve and store energy reserves in the form of fat, whereas hyperthyroidism in the winter would enable them to use these fat reserves to maintain thermal homeostasis.

These changes fit nicely with the genetic alterations of the amygdala and hypothalamus identified by Saetre and colleagues (2004) and the thyroid hypotheses posited by Hiestand (1989) and by Crockford (2002). Reduced hypothalamic NPY activity might result in periodic shifts toward hyperthyroidism coincident with critical prenatal and postnatal developmental periods that might result in adult changes inclining toward hypothyroidism via neural sensitization and enhanced negative feedback regulating thyroid release. These alterations in thyroid activity might also reduce the number of CRF neurons in the central nucleus (thereby reducing HPA-axis reactivity) while supporting connectivity between NPY interneurons in the basolateral complex with mesolimbic and orbitofrontal reward circuits projecting to the lateral hypothalamus, completing a feedforward loop involving orexin-mediated excitatory effects on NPY activity. According to this hypothesis, orexin neurons in the lateral hypothalamus may play a prominent role in the modulation of NPY neurons in the process of mediating hedonic value and a heightened state of alertness, action readiness, and increased exploratory activity, as discussed previously in this section. In addition, a network of neural activity of this sort is consistent with enhanced antistress capabilities, increased sociability, and adaptive optimization.

Survival Modes, Control Incentives, and Reward

The relatively small social and dietary QOL enhancements needed to mobilize mode changes suggest the involvement of conditioned associations, perhaps involving NPY regulated release of arginine vasopressin

(AVP) and oxytocin (Sheikh et al., 1998). Among rats, for example, food deprivation results in a persistent state of biological distress that elevates AVP activity, promotes adrenal hypertrophy, and mediates a twofold increase in NE turnover in brainstem (El Fazaa et al., 2000). Food- and water-deprived rats also show elevated glucocorticoid levels and a potentiated increase in catecholamine release in response to acute immobilization (Kiss et al., 1994). In contrast, the closely related neuropeptide, oxytocin, plays many complementary antistress and antiaggression roles by way of linkages among sucking, ingestion, tactile stimulation, social affiliation, and autonomic attunement antagonistic to the stress-mediating effects of AVP. These oxytocin effects are consistent with an important role in the activation of the social engagement system (SES) and the integration of secure attachments. AVP and oxytocin appear to modulate thresholds regulating autonomic tone and a dog's ability to obtain hedonic value from social, appetitive, and tactile exchanges while organizing an adaptive coping style (Ostrowski, 1998).

AVP is hypothesized to play a role in mediation of state changes underlying nervous attachments, irritability, and repulsion consistent with the loner-dispersal mode, whereas oxytocin promotes changes consistent with secure attachments, including the calming, comfort and safety, and pleasure derived from eating, petting, and warmth. According to this hypothesis, oxytocin may increase neural activity in pathways conducive to social engagement by lowering the excitation thresholds of neurons and circuits mediating increased parasympathetic tone and attributing positive hedonic value (attraction and calming) to social attention, appetitive rewards, and tactile stimulation. In contrast, AVP may route neural activity consistent with the loner-dispersal mode by lowering excitation threshold of neurons and circuits mediating sympathetic arousal and attributing negative hedonic value (aversion and agitation) to social attention, appetitive rewards, and tactile stimulation, thereby increasing social irritability, intolerance, and autoprotective behavior. Neuropeptide-mediated alterations of neuronal responsiveness to the hedonic value of social stimuli would serve a potentially beneficial function by limiting attachment behaviors to appropriate social partners. Consistent with such social functions, oxytocin and AVP play complex roles in the establishment of durable social memories (e.g., kin recognition) and affiliative bonds, as well as mediate potent states of social aversion and aggression toward unfamiliar conspecific intruders.

Although the survival mode is immensely influential, it does not dictate the behavior expressed by a dog but rather serves to modify behavior by altering the incentive and hedonic value of social exchange. According to the integrate-or-disperse hypothesis, the hedonic value of social exchange may shift depending on the survival-mode active at the time (see *Diet Change and the Integrate-or-Disperse Hypothesis* in Chapter 7). In particular, the hypothesis predicts that QOL enhancements in the absence of increased affiliative exchange promote anxiety and insecure attachments. A further prediction asserts that QOL diminishments made while increasing social interaction tend to promote dispersive tensions, which, if blocked, generate social ambivalence and entrapment dynamics. Consequently, persistent exposure to inescapable social situations that provide poor QOL resources (entrapment) but nevertheless make high demands on a dog for social contact, may amplify dispersive tensions and promote antipredatory and autoprotective adjustments in response to ambiguous signals. Accordingly, QOL changes may generate significant motivational changes promoting social integration or dispersion, depending on the availability of adaptive social options consonant with the activated survival mode.

The quality of social or place attachments exerts an immense effect on the hedonic value of transactions resulting in social and appetitive reward. For example, under circumstances perceived as secure, the contingent delivery of social attention, tactile stimulation, and play may produce positive hedonic value and state changes conducive to social attraction and integration. In contrast, under the influence of circumstances perceived as insecure or unsafe, the same social exchange will produce

aversive state changes conducive to reactive adjustments and social dispersion. The reward value of affectionate petting and hugging will greatly vary, depending on the survival mode active at the time of receiving it and the quality of attachment between the dog and the person giving it. Whereas petting and hugging or playful teasing may yield a high degree of positive hedonic value (e.g., calming and enjoyment) for a dog operating under the influence of autonomic attunement and secure attachments (social integration mode), the autonomic state changes and physiological alterations of neuronal substrates and target organs mediating the loner-dispersal mode may cause such playful and affectionate actions to yield a negative hedonic value (e.g., resentment and irritability), especially in the presence of a QOL diminishment.

Survival Modes, Energy Homeostasis, and Stress

During stressful arousal in anticipation of increased energy demands, complex physiological changes are orchestrated to protect or restore energy homeostasis. Thus, neuropeptide signals (principally CRF and AVP) converging on the pituitary modulate the release of adrenocorticotropic hormone (ACTH) into the bloodstream. ACTH stimulates the adrenal cortex to release glucocorticoids, thus activating numerous metabolic, anti-inflammatory, and cognitive-emotional changes conducive to adaptation and energy homeostasis. The size of this adaptation and denouement phase (allostasis) is followed by several key changes affecting flight-or-fight thresholds. The activation of the HPA axis and the release of adrenal glucocorticoids into the bloodstream promotes a state of positive energy balance (excess), whereas the activation of the HPT axis in response to severe stressors produces an energy deficit by increasing the metabolic rate (Horvath et al., 2004).

In addition to the varied caloric requirements needed by working dogs to maintain energy homeostasis, genetic peculiarities may influence a dog's capacity to anticipate and efficiently supply the changing energy requirements needed by the brain and body to support goal-directed behavior. The recent finding that a structure of genetic relatedness between different dog breeds collects principally around four clusters of genomic variation (Parker et al., 2004) raises the possibility that individuals belonging to these different genetic groups may express digestive and metabolic variations that require different nutritional support to achieve energy homeostasis. For example, Frank (1987) has reported preliminary evidence suggesting that Northern breeds (e.g., the malamute) may possess more efficient metabolic capacities than other dog breeds or wolves. The metabolic and nutritional requirements of breeds specialized for sprint racing and long-distance racing varies significantly. Whereas sled dogs appear to perform best when fed diets containing high fat (50%) and high protein (30%), greyhounds appear to perform best when fed diets containing more moderate levels of fat and protein (Hill, 1998). The groupings identified by Parker and colleagues may provide a valuable frame of reference for investigating nutritional differences and, if necessary, formulating canine diets compatible with the specific needs identified. According to this hypothesis, diverse breeds, such as the Bernese mountain dog, greyhound, and the Shiba Inu, have probably evolved very different nutritional requirements and metabolic capacities due to local customs and food availability. A mismatch between a dog's diet and its breed-specific and individual differences affecting metabolism may result in compensatory appetitive and motor efforts to achieve the requisite state of balance and metabolic repose.

A failure to achieve a state of metabolic comfort and energy homeostasis may mobilize disorganized striving and increased catecholamine activity via the activation of sympathetic-adrenomedullary (SAM) system. Whereas epinephrine appears to play a prominent role by mobilizing a rapid state of generalized arousal and increased glucose metabolism (McGuinness et al., 1997), NE appears to mediate lipid metabolism in preparation for sustained physical exertion (Connolly et al., 1991). In addition to promoting rapid preparatory thermogenic and visceral changes

serving to prime and mobilize the emergency system into a state of heightened arousal and readiness, the SAM system exerts excitatory cardiovascular and muscle-tone changes inclining dogs toward confrontation or retreat (see *Periaqueductal Gray and Autoprotective Adjustments to Social Stressors*). Verrier and Dickerson (1991) found that NE predominates the catecholamine flow evoked by anger in dogs. Among cats, different catecholamine proportions emerge, depending on the nature of psychological stressors presented (Stoddard et al., 1987). Among dogs, NE released at $ß_1$-adrenergic receptors appears to play a prominent role in mobilizing cardiovascular changes associated with acute anger states, with cardioselective $ß_1$-adrenergic antagonist, metoprolol-blunting T-wave alternans (TWA), a heart beat pattern reflecting cardiac instability that is evoked by anger and stress, not a secondary instability resulting from an elevated heart rate. This research suggests the possibility that TWA, perhaps in conjunction with heart-rate variability tests, may provide a useful marker for evaluating sympathovagal tone and canine aggressive propensities in response to anger-evoking stimulation (see *Heart-rate Variability* in Chapter 9). Interestingly, sympathectomized dogs (Brouha et al., 1936; Brouha and Nowak, 1939) or dogs under the influence of strong ß-adrenergic blockade (Roossien et al., 2000) show evidence of parasympathetic-driven cardiac accelerator effects conduced by vagal receptors, perhaps mediated by the combined action of acetylcholine and vasoactive intestinal peptide (VIP) (Roossien et al., 2000). Brouha and colleagues (1936) include a photograph of two dogs straining on leashes to fight, even though the sympathetic pathways of both dogs had been surgically disrupted. Despite severe sympathetic impairments, the dogs appeared to show normal running, jumping, playing, and active and passive defensive reactions, suggesting that sympathetic arousal systems are integrated into voluntary behavior at another level of neural organization.

Dogs cope with exchanges perceived as challenges or threats by increasing arousal, vigilance, and readiness—changes that are mediated by cortical and limbic signal converging on the hypothalamus. The activation of emotional systems involved in coping with psychological stressors and demands causes numerous endocrine changes that shift the body into a catabolic state in anticipation of energy outflow. As conflict is resolved, these catabolic processes are substituted by increased anabolic activity organized to conserve and restore energy reserves and to mediate energy conservation, bodily repair, and healing. By means of prior exchanges with others and the environment, predictive information is acquired that enables dogs to match adaptive control efforts with the energy resources needed to succeed. Under conditions of chronic interactive conflict, a state of persistent heightened arousal and *vigilance* (anxiety) may result in a chronic state of physiological stress affecting a dog's ability to competently utilize, produce, and conserve metabolic resources in a manner that promotes energy homeostasis and heath. In addition to the adverse stress effects of persistent anxiety, appetitive frustration promoting heightened arousal and *action readiness* may exert damaging effects on the body and behavior. For example, extinction procedures have been shown to increase HPA-axis activity. Several studies investigating the physiological effects of extinction have shown that rats and monkeys experience a significant rise in glucocorticoid release when exposed to appetitive extinction procedures. Although an increased frequency of reward results in a decrease of glucocorticoid activity during the acquisition phase of training, rewards that fall short of expectations result in increased glucocorticoid activity (Lyons et al., 2000), suggesting that circuits regulating the HPA axis are sensitive to positive and negative prediction error signals. During the extinction phase of a control module, the magnitude of change in HPA-axis activity is proportional to the value of the rewards obtained during the acquisition phase of training (Kawasaki and Iwasaki,1997). The increased active modal activity that often occurs during the initial extinction phase appears to be corticosterone-mediated, with adrenalectomy abolishing the extinction burst in rats (Thomas and Papini, 2001).

Circulating glucocorticoids enter the brain and interact there with mesolimbic dopamine

pathways, perhaps playing a facilitative role in the process of extinction by mediating the expression of active modal strategies in response to surprising nonreward, to borrow Papini's term (Papini, 2003). Instrumental extinction is an active learning process, whereby the animal preserves the general structure and sequential organization of a previously effective action pattern, while exploring and experimenting with the changed situation in an effort to restablish and optimize effective control (see Neuringer et al., 2001). Whereas the acute activation of the HPA system in response to the temporary loss of control over a previously controllable attractive or aversive event may augment adaptive capacities, chronic exposure to distressing frustration and anxiety in association with uncontrollable motivational events appears to gradually diminish the dog's ability to experience reward and to integrate an adaptive coping style. The net result of chronic stress is a reduction of purposive reward-seeking activity in combination with mood changes conducive to social withdrawal, anxiety, irritability, and incompetence. The widely held assumption that the activation of the HPA-axis is indicative of adverse stress is obviously flawed. The foregoing findings suggest that cortisol measures may not be a very useful stand-alone indicator of the dog's welfare status. In fact, a robust adrenal release of cortisol in response to the disconfirmation of expectant prediction-control efforts appears to actually facilitate behavioral changes conducive to adaptive optimization. Actually, one might better argue that diminished HPA-axis activity in response to the repeated disconfirmation of a previously reliable control module would be more indicative of disruptive stress and allostatic load than adaptive stability.

Dog breeds and individuals show significant differences in their ability to cope and adjust to adverse environmental circumstances. Hydbring-Sandberg and colleagues (2004) have reported that dogs showing low-auditory startle thresholds in response to gunshots exhibit a robust cortisol and progesterone response not shown by dogs exhibiting high-startle thresholds. The same loud-noise stimulation has little effect on the release of cortisol and progesterone in the latter, less sensitive group. Interestingly, the experimenters found that baseline measures (e.g., heart rate, hematocrit values, cortisol, progesterone, endorphin, and vasopressin) taken from fearful and fearless dogs did not significantly differ. The relative dependence of stress-related adjustments on the vagaries of individual difference raises significant questions concerning the objectivity of assumptions and generalization regarding the intrinsic stress potential of different classes of sensory stimuli. The blast of a shotgun for a hunting dog signals a very different chain of associative events than the blast produced by a firecracker thrown into the backyard. Similarly, careening down a snow-covered mountain on long fiberglass runners fastened to the feet would represent a robust and terrifying experience for a nonskier but be a source of pleasurable exhilaration for an expert skier. The key differences between stressors and nonstressors revolve around relative predictability, controllability, and familiarity, on the one hand, and the possession of appropriate skills and the confidence needed to use them effectively, on the other. The study draws into serious doubt the value of psychological stress studies that fail to separate dogs into test groups based on behavioral thresholds and temperament types.

Genetic Influences on Adaptive and Reactive Coping Styles

Dopamine Regulatory Polymorphisms and Reactive Behavioral Phenotypes

Complex interactions between hereditary influences and experience influence how dogs cope with adversity (loss of control). The way a dog responds to novelty and unexpected events appears to exert a profound stabilizing or destabilizing influence on its temperament and coping style. There are four general ways in which the dog responds to novelty and strangeness: fearlessly, conflictively, aggressively, and fearfully. A possible genetic factor affecting how dogs respond to novelty and unfamiliar persons or other dogs may be traceable to polymorphisms regulating the

expression of DA receptors, especially D_2 and D_4 subtypes (see *Neural and Physiological Substrates* in Volume 2, Chapter 5). Mice lacking the D_4-receptor gene show a significant reduction of exploratory behavior and increased approach-avoidance conflict toward novel objects in comparison to wild mice (Dulawa et al., 1999). The functional significance of D_4-receptor polymorphisms on temperament in humans is currently controversial and clouded with contradictory findings (Kluger et al., 2002). Whether D_4 polymorphisms adversely affect canine adaptive behavior is unknown, but some intriguing evidence is highly suggestive with regards to the possibility of such an effect. Niimi and colleagues (1999) have reported significant differences in the distribution of D_4 alleles in the genomes of the golden retriever and the Shiba inus. They have cautiously suggested that these genetic variations may contribute to some of the temperament differences exhibited by these two breeds. For example, the long D allele prominent in the Shiba inu may contribute to the breed's reputed territoriality and propensity for reactive excitability toward other dogs. The Shiba also appears to express variant D_4 alleles not found in the genome of other dog breeds thus far studied (e.g., beagle, sheltie, golden retriever) (Niimi et al., 2001), consistent with the breed's ancient origins and relatively close genetic relationship with the wolf (see Parker et al., 2004).

Another line of relevant research in dogs has investigated polymorphisms affecting the gene responsible for the production of catechol-O-methyltransferase (COMT) (Masuda 2004), an enzyme that metabolizes dopamine and norepinephrine (Tunbridge, 2004). The polymorphisms affecting the canine COMT gene are similar to those that have been identified in humans, suggesting that COMT may play a role in the elaboration of dopamine-related predispositions underlying certain adjustment problems. Tunbridge and colleagues (2004) have reported that the inhibition of COMT release at the level of the prefrontal cortex serves to enhance attention functions by increasing dopamine availability. Interestingly, the effects of COMT are only evident under conditions of increased arousal when increased prefrontal dopamine activity appears to facilitate flexible attention shifting. These findings are consistent with the hypothesis that polymorphisms affecting the COMT gene may contribute to selective attention and impulse control deficits associated with impulsive aggression. Too little or too much dopamine release in the PFC at times of increased arousal appear to be conducive to impulsive and reactive adjustments. These findings suggest the possibility that polymorphisms affecting the dopamine transporter gene might also contribute an adverse predisposing influence affecting the functional competency of executive functions.

Breed and Individual Difference and Reactive/Impulsive Behavior

Breed and individual differences affecting excitability, emotional reactivity (anger and fear thresholds), and cognitive organization (attention and impulse control) exert significant influences on how dogs cope with the conflictive exchange and emotional tensions generated by social ambivalence and entrapment (James, 1939; Sgoifo et al., 1996). Van Der Velden and colleagues (1976) described a pattern of impulsive CDA exhibited by a population of Bernese Mountain dogs in the Netherlands. Of 800 questionnaires sent to owners, 404 were returned and analyzed. The researchers found that not less than 20% of the owners reported that their dog had attacked family members intermittently with "blind aggressiveness" (404). The dogs that had threatened owners or delivered attacks were most often males (76%), whereas females were over represented in the group showing shyness and "unbalanced" temperaments only when away from their home territory. The attacks exhibited by the affected dogs were episodic and out of character with otherwise friendly behavior. Some of the dogs appeared insecure (shy and nervous) while others were reported to exhibit hypersexual behavior. The provoking stimulus was frequently a command or prohibition, even when given in a friendly and nonthreatening way. Some of the dogs responded to the least amount of restraint or force with "real panic"

(404). Often the owner was unable to identify an evoking stimulus triggering the attack. Dogs showing this behavior were reported as shy or avoidant as puppies, especially with respect to strangers. As puppies and adults, the dogs showed a "clear lack of communication" (404). The owners described a rutilant glow in the dog's eyes immediately before the attack took place. Attacks were directed against family members in circumstances consistent with a dominance-aggression interpretation. Interestingly, when rehomed aggressors only began to attack family members again after they had established social attachments with them. Since the attacks were described as resembling impulsive fits or seizures, a series of neurological tests [kindling and electroencephalogram (EEG)] were performed to exclude epilepsy. In addition, necropsies and microscopic examination of the brain tissue from 8 dogs found no evidence of pathology. Intracranial EEG recordings of 7 dogs presenting varying signs of reactivity, including a history of attack behavior, were taken by inserting electrodes bilaterally into the temporal and orbitofrontal cortex, the amygdala, and the hippocampus. The testing failed to reveal evidence of epileptic-like spontaneous activity. The authors stress the likely role of genetic factors in the etiology of the impulsive aggression exhibited by these dogs.

Other breeds, notably the cocker spaniel and English springer spaniel, have also attracted clinical and scientific interest stemming from similar presenting signs, often collectively described as dominance-related. Mugford (1984) found that English cocker spaniel dogs (N=50) with aggression problems, showed a highly uniform pattern of attacks directed exclusively against family members in association with moodiness and the defense of bones, food, and defended areas (e.g., under furniture). Aggressive propensities appeared to decrease when the dogs were in less familial surroundings. Male dogs delivered most attacks (68%), with males also showing more severe aggression than females. The eyes of attacking dogs changed color and the attack worsened as the result of physical punishment. Most dogs appeared confused and contrite after the attack. Mugford's data suggests that a linkage between temperament and coat color may exist in the English cocker spaniel, since 74% of the aggressors were red or golden in color, 20% were black, 6% were designated as other (e.g., parti-colored); a relationship later confirmed by Podberscek and Serpell (1996). The apparent reduced incidence of aggression in parti-colored English cocker spaniels is consistent with data collect by Belyaev and colleagues (Trut, 1999). Belyaev's group found that piebald pelage is highly correlated with tameness in foxes (see *The Silver Fox: A Possible Model of Domestication* in Volume 1, Chapter 1).

A similar pattern of dominance-like behavior has been reported to occur disproportionately among English springer spaniels. According to Reisner (1996), the English springer spaniel is the breed presenting most frequently for treatment of dominance-aggression problems. The results of a large questionnaire survey involving 1,053 springer owners (53.1%) indicate that 26.4% reported that their dog had bitten someone, which was often a family member or a person familiar to the dog (65.2%) (Reisner, 1996). Reisner reports that nearly half (48.4%) of these domestic aggressors had growled, snapped, or bitten in situations associated with dominance. In a sample of 53 cases involving springer spaniels diagnosed as dominance-related aggression, males presented twice as often as females (Reisner, 1993). Again, attacks were most common around food and prized objects, with dogs also showing aggression in response to punishment or when disturbed while resting or sleeping. Interestingly, with respect to a possible genetic defect, a statistic analysis of pedigree data revealed that a particular kennel and sire was highly associated with dogs showing the aggressive trait ($p=0.002$) (Reisner, 1996), suggesting the possibility of a popular sire effect (see *Prospects for the Future* in Volume 1, Chapter 1). The results of a similarly large survey of English cocker spaniel owners also found evidence of a combined genetic and behavioral influence, but then conclude that domestic attacks occurring suddenly and without apparent provocation are not of some separate

category (Podberscek and Serpell, 1996), but are "clearly associated with other symptoms of dominance-type aggression" (87) and therefore should be interpreted in terms of social dominance incentives. In addition to intrafamilial aggression, the authors found that a large percentage of the dogs showed extrafamiliar aggression, threatening or attacking persons visiting the home or strangers away from home. Allen and colleagues (1974) have described a sibling group of Alaskan malamutes that showed severe fighting and predatory behavior that support the notion that individual constitutional influences may strongly affect breed propensities toward intraspecific trait and predatory aggression, since other sled dogs raised under similar circumstances did not show the sort of extreme aggression exhibited by these dogs. After bilateral mechanical disruption and aspirative ablation of the prefrontal cortex, several of the dogs showed a pronounced reduction of fighting and killing behavior, without impairing their drive to pull a sled. In contrast, many of the family dogs presenting with domestic aggression problems showed improvement while in the laboratory, but little of this change transfered to the home, consistent with a complex etiology involving both genetic vulnerability and additive experiential influences.

NEUROBIOLOGY AND LOSS OF ADAPTABILITY

Neuopeptides, Monoamines, Impulsivity, and the Dissolution of the Bond

Aggression is of particular interest from a theoretical cynopraxic standpoint insofar as it represents the castastrophic dissolution of the social bond and thus mirrors in reverse significant factors influencing the bonding process. Social interaction perceived as ambiguous, uncertain, or uncontrollable (i.e. portending a potential loss or risk) may acutely activate NE and DA pathways in the process of enhancing vigilance (NE) and readiness (DA) to cope with the challenge or threat. The arousal mediating impulsive CDA probably originates at a preattentive level that reaches a catastrophic point of no return while the dog is preoccupied with conflict monitoring, suggesting that the diversion of attentional resources away from executive prefrontal functions to cope with social conflict may play a critical role in the mediation of impulsive aggression (see *Cortical and Subcortical Comparator Functions and Adaptation*). The risk of catastrophic impulsivity and aggression is particularly high in the case of ambiguous (uncertain) social signals or social demands forcing the dog to make conflict-laden choices between unacceptable alternatives. According to this hypothesis, chronic social ambivalence and entrapment diverts attentional resources away from executive functions (selective attention and impulse control) to conflict monitoring, a process that disrupts the dog's ability to competently regulate emotion, integrate an adaptive coping style, and to competently inhibit or disinhibit aggressive impulses.

Although a causal linkage between frontal serotonergic activity and aggression in dogs has not been definitively established, speculation implicating 5-HT in the etiology of aggression has long circulated in the applied and veterinary literature. However, most of this speculation has focused on the aggression-facilitating effects of 5-HT deficiencies. The present hypothesis suggests that both deficiencies and excesses of prefrontal 5-HT and DA may promote impulsivity (Dalley et al., 2002) and aggressive behavior (see De Boer et al., 2003). Depending on the specific receptor subtype, 5-HT appears to exert variable inhibitory and disinhibitory neuromodulatory effects over motivated behavior. On the one hand, psychological stressors may alter 5-HT function by various mechanisms. The adverse effects of altered 5-HT activity may be further amplified or attenuated by changes to the 5-HT transporter. For example, the principle antianxiety and antiaggression benefits of serotonergic medications is probably mediated by the inhibition of 5-HT transporters, thus enhancing the neurotransmitter's capacity to linger longer in the synaptic cleft and to modulate other neurotransmitters and neuropeptides conducive to relaxation, social attraction, and an adaptive coping style. In contrast, however, under the

influence of excessive 5-HT activity, some 5-HT receptors may mediate problematical inhibitory or disinhibitory influences over impulsive and reactive behavior via disruptive interaction with glutaminergic, dopaminergic, and GABAergic pathways. Depending on the type and chronicity of the stressors involved, stress-mediated deficiencies or excesses of 5-HT and DA may perturb selective attention, impulse control, and mood. According to this hypothesis, chronic stress results in disturbances affecting 5-HT modulatory function, while disrupting the integrative functions of DA, thereby impairing the dog's ability to organize control modules in a proactive and competent fashion. Effective cognitive processing and emotional regulation requires a precise balance of inhibitory, disinhibitory, and excitatory neuromodulation, that is, autonomic attunement and allostasis.

Oxytocin- and AVP-containing neurons express a variety of 5-HT receptor subtypes that promote a diversifying function on arousal and behavior (see *Oxytocin, Arginine Vasopressin, and Autonomic Attunement* in Chapter 8) via the release of oxytocin and AVP in response to stress. Both oxytocin and AVP neurons express $5HT_{2A/C}$ receptors, but only oxytocin neurons express $5\text{-}HT_{1A/B}$ receptors (Jorgensen et al., 2002). $5\text{-}HT_{1A}$ receptors may exert a major modulatory effect over the antianxiety and antiaggression effects mediated by oxytocin. $5\text{-}HT_2$, $5\text{-}HT_4$, and $5HT_7$ receptors appear to play prominent roles in AVP-mediated behavioral and physiological effects (Jorgensen et al., 2003a). Also, circulating cortisol entering the brain appears to selectively inhibit AVP and CRF release but spares oxytocin, leaving it unchanged (Papanek and Raff, 1994), suggesting that central oxytocin may perform a post-stress calming effect, consistent with an amnestic reconciliation function. Petting the stressed dog may facilitate this calming forgetfulness and facilitate social attraction by augmenting the release of central oxytocin. The oxytocin stimulating effects of petting and praise (vocal petting) appear to mediate the cumulative bond-enhancing and calming effects of basic training (see *Neuropeptides and Social Behavior* in Chapter 4 and *Oxytocin-opioidergic Hypothesis* in Chapter 6).

During episodes of acute stress AVP appears to augment the CRF-mediated release of adrenocorticotropic hormone (ACTH) (Klingbeil et al., 1988). Keck and colleagues (2002) found that an AVP receptor antagonist blocks the stimulatory effect of CRF on ACTH release in high-anxiety rats, supporting the hypothesis that AVP plays a mediational role in the expression of individual differences in response to acute psychological stressors. Although acute stress facilitates the production of both AVP and CRF, chronic stress exerts a differential upregulating effect on AVP while downregulating CRF activity (Ma and Lightman, 1998). As a result of exposure to chronic restraint stress, both CRF and glucocorticoid activity are reduced over time, whereas AVP gene expression is increased. The $5HT_{2A}$ receptor is known to control the release of AVP at the paraventricular nucleus (Ramage, 2001; Jorgensen et al., 2003b) and to modulate NE release by the locus coeruleus (Millan, 2003), while NE regulates the release of CRF (Itoi et al., 1999), which in turn modulates the release of 5-HT via the dorsal raphe nucleus (Thomas, et al., 2003) (see *Septal Distress, Relief, and Panic*). The notion that glucocorticoid activity decreases over time while AVP levels increase draws into question the value of cortisol levels as an objective index for assessing the welfare implications of chronic stressors, suggesting that AVP levels and AVP-related indicators such as antidiuresis, thermogenesis (elevated body temperature), cardiovascular changes as reflected in heart rate, heart rate variability (HRV), and blood pressure, and other compensatory behavioral and physiological adjustments (e.g., persistent hyperpnea), might represent more useful endophenotypic markers of allsostatic load resulting from chronic stress than isolated cortisol levels (see *Restraint, Unavoidable Aversive Stimulation, and Stress*). The foregoing findings suggest that exposure to chronic psychological stress (social ambivalence and entrapment) may promote either allostatic hyperdrive (high cortisol) or hypodrive (low cortisol) depending on the neural systems activated

and the nature of the stress. Whereas acute stressors activate reactive adjustments in association with allostatic hyperdrive and *hypercortisolism*, exposure to chronic stress and allostatic hypodrive in association with increased NE and AVP activity may switch on a PSM conducive to impulsivity.

Social exchanges posing difficult to discriminate options or ambiguity are a source of significant distress for dogs operating under the influence of entrapment and social ambivalence. The diversion of attention to monitor conflict may drain the executive resources needed to process and select behavioral options. With the reduction of executive capacities to maintain selective attention, the nodal regulation of sympathetic arousal may be disrupted, threatened with dissolution, and loss of impulse control. The resulting state of reactive readiness and vigilance may rapidly saturate available inhibitory networks and flood the dog with emotional pain and anger. Thus, impulsive CDA appears to involve the breakdown of the autonomic attunement and mutual awareness that emerges in response to social exchanges that mediate the friendly familiarity, belongingness, and the caring protectiveness of secure attachments. If the owner at such times would merely withdraw from the dog, the sequence of events might be averted, allowing dysregulated arousal to subside and the threat to pass. However, if the dog is further aroused by encroachment and nervous ambiguity or worse yet physical punishment it appears to enter a momentary state of utter incompetence and confusion or lapse of awareness as a catastrophic flash point of no return is reached. Hoaken and colleagues (2003), referring to disturbances of impulse control in human aggressors, nicely state the situation with respect to impulsive CDA, as well:

> Aggression is a primal social response option, a simple response option to an exceedingly rich and complex mélange of contextual cues. It may be that individuals with poor ECF (executive cognitive functioning), demonstrating poor social information processing skills and an inability to cope with overwhelming response options, fail to access more socially appropriate options and make default aggressive responses to provocative situations. (28)

Stress, 5-HT_{2A} Receptor Upregulation, and Aggression

Recent developments in neurobiological research are making significant progress with respect to getting a handle on the neural disturbances contributing to the development of impulsive CDA. For example, a neuroimaging study performed by Peremans and colleagues (2003ab) suggests a possible link between impulsive aggression and an imbalance of central serotonin activity. The researchers found that dogs with a history of serious aggression problems show evidence of increased 5-HT_{2A} receptor binding potential in frontal cortex. No significant differences were found in the receptor binding characteristics of aggressive and nonaggressive dog with respect to 5-HT_{2A} receptor expression in subcortical areas. Nor were there significant differences between aggressive and non-aggressive dogs in terms of regional cerebral blood flow. The aggressive dogs studied were referred for imaging by behavioral consultants and all of the dogs had been diagnosed with "dominance aggression." Precisely why aggressive dogs show increased cortical 5-HT_{2A} receptor binding potential is unknown, but at first glance, given the common assumption that "dominance aggression" is due to a lack of synaptic 5-HT, one might be tempted to interpret the increased binding potential as an adaptive upregulation of receptor activity in response to decreased 5-HT (Walsh and Dinan, 2001). The upregulation hypothesis is problematical since the 5-HT_{2A} receptor does not appear to upregulate in response to reduced synaptic 5-HT (Peremans et al., 2003b). Although chronic exposure to decreased 5-HT release might result in alterations affecting 5-HT_{2A} receptor sensitivity and numerous other changes influencing 5-HT function, decreased 5-HT levels alone might not account for the receptor binding changes found in aggressive dogs. Another possible explanation for the increased binding index exhibited by such dogs is prior exposure to antidepressant medications commonly used to treat canine aggression problems. Chronic fluoxetine treatment in rats has been shown to significantly increase the density of 5-HT uptake sites and to upregulate the expression of 5-HT_2 receptors in the frontalparietal cor-

tex by 31-38% (Hrdina and Vu, 1993). However, none of the dogs enrolled in the present study had ever received psychotropic drugs, modified diets, or behavioral therapy prior to the imaging study (Peremans, personal communication, 2003), thus excluding a drug effect as a possible explanation. The lack of differences between aggressive and nonaggressive dog pertaining to cerebral blood flow is a bit surprising and might represent an artifactual peculiarity of the study design, which required that the dogs be anesthetized for brain imaging.

Early developmental stress may exert influential effects on the organization of reactive thresholds. Prenatal stress has been shown to promote widespread changes affecting the organization of most major neurotransmitter systems so far studied (see *Ontogeny, Coping, and Social Behavior*). In addition to the impact of elevated maternal glucocorticoids reaching the fetal brain, perinatal gonadal hormones may alter the expression of serotonergic pathways in the young dog that may affect the adult dog's vulnerability to psychological stress. Early social stressors have been implicated in numerous neurophysiological changes relevant to attachment problems and aggression, including the upregulation of the 5-HT_{2A} receptor. For example, rats given corticosterone or ATCH for 10 days show a significant increase of 5-HT_{2A} receptor binding potential in the frontal cortex (Takao et al., 1995; Takao et al., 1997; Kuroda et al., 1992). Also, cortisol has been shown to increase the expression of 5-HT transporter sites in vitro (Tafet et al., 2001), raising the possibility that increased glucocorticoid levels resulting from chronic stress might increase the re-uptake efficiency of serotonergic terminals, causing 5-HT to be rapidly cleared from the synaptic cleft. Such an enhancement of 5-HT transport could result in the premature termination of 5-HT-mediated neural transmission. Under a highly motivated state, rapid clearance of 5-HT could result in muddled judgment, behavioral dysregulation, and the catastrophic sequencing and loss of control associated with impulsive aggression.

In addition to stress-related endocrine changes, sex steroids also appear to exert an upregulating effect on 5-HT_{2A} receptors in frontal and cingulate cortical areas of rats (Sumner and Fink, 1998). Male rats show a greater concentration of 5-HT_{2A}-receptor activity in the ventromedial hypothalamus, a gender dimorphism that is eliminated by castration (Zhang et al., 1999). The ventromedial hypothalamus is associated with the expression of affective aggression [see *Neurobiology of Aggression (Hypothalamus)* in Volume 1, Chapter 3]. Isolation rearing can also enhance 5-HT_{2A} receptor binding and increase aggressive behavior (Sakaue et al., 2002), conversely, enhanced 5-HT_{1A} receptor activity appears to exert an antiaggression influence. Similarly, among cats the 5-HT_{1A} receptor appears to mediate an inhibitory effect over affective aggression, whereas the 5-HT_2 receptor may facilitate it (Gregg and Siegel, 2001). 5-HT_{1A} agonists exert potent inhibitory effects on 5-HT_{2A}-mediated behavior as well as downregulating the 5-HT_{2A} receptor (Eison and Mullins, 1996). 5-HT_{1B} agonists have also been shown to exert a potent inhibitory effect on aggression between rats facilitated by frustration and social instigation (de Almeida and Miczek, 2002). Interestingly, a prominent effect of 5-HT_1 receptors is to exert an inhibitory autoreceptor effect over the release 5-HT, with 5-HT_1 agonists reducing synaptic 5-HT availability.

Panic, Separation Distress, and Aggression

Increased dopamine (DA) activity stimulated by apomorphine has been shown to upregulate the 5-HT_{2A} receptor as well as to facilitate the expression of impulsive behavior, including aggression in predisposed animals (Matto et al., 1999), however, increased 5-HT_{2A} activity does not appear to alter the latency or intensity of apomorphine-mediated aggressive behavior, at least among rats (Skrebuhhova-Malmros et al., 2000). Aggression mediated by dopaminergic pathways may either be facilitated or inhibited by 5-HT_2 receptor activity depending on the cortical or subcortical site and the receptor subtype involved. For example, the 5-HT_{2A} receptor appears to mediate a phasic disinhibitory influence (i.e.,

lifts tonic inhibition) over cortical DA release in response to anticipated social stressors, while 5-HT_{2C} receptors appear to exert a tonic inhibitory effect (Gobert and Millan, 1999). At the level of the ventral tegmental area (VTA), 5-HT_{2C} appears to promote phasic and tonic inhibitory influences over the release of DA (Di Matteo et al., 2002), whereas the 5-HT_{2A} receptor mediates a phasic disinhibitory influence over DA release. Prefrontal regulatory influences over mesolimbic reward circuits is also mediated by the modulatory effects of 5-HT on excitatory glutaminergic pathways projecting to the VTA and the nucleus accumbens (Charney, 2004). In addition to receiving glutaminergic input from the amygdala, the thalamus also communicates with the mPFC via a glutaminergic circuit (Martin-Ruiz et al., 2001)—a circuit that might produce significant disruption of executive function and perceptual disturbance in cases where 1A- and 2A-receptor activity is in a state of flux or imbalance. Elevated DA activity, increased 5-HT_{2A} receptor binding potential, and disturbances affecting 5-HT or DA clearance within the PFC may combine to produce devastating cognitive disturbances. Hallucinogens (e.g., LSD) exhibit a high affinity for the 5-HT_{2A}-receptor subtype, suggesting the possibility that some impulsive attacks may be associated with perceptual confusion or hallucination.

Prefrontal 5-HT and DA systems undergo alteration as the result of aggressive interaction. Van Erp and Miczek (2000), for example, have shown that episodic fighting between rats produces a potent effect on prefrontal DA and 5-HT balance, resulting in a sustained 120% increase of DA and an 80% decrease of 5-HT turnover in the mPFC. In a parallel study performed in the same laboratory, found that repeated aggressive encounters between rats resulted in conditioned changes in heart rate and the release of DA and 5-HT in anticipation of a fight (Ferrari et al., 2003). In this study, aggressive rats were brought together to fight on 10 consecutive days at precisely the same time. On day 11 the scheduled fight was cancelled and various real-time measurements were taken to assess 5-HT and DA activity. During the hour immediately before the usual fight time, the rats showed a conditioned increase of heart rate and a potent efflux of accumbal DA. The 5-HT levels of experienced rats stayed relatively constant throughout, until approximately several minutes before the normally scheduled fight, whereupon 5-HT levels dipped and decreased by 30-35% over the next hour or so before slowly returning to baseline levels. During the first fight encounter, in contrast, 5-HT levels showed a slight dip during the fight period itself and remained relatively steady for 30 minutes, during which time DA levels increased with the onset of the fight and continued to increase over the course of the same 30-minute period. The subsequent increase of DA appeared to shadow a decrease of 5-HT levels, suggesting that 5-HT may exert an inhibitory effect on DA activity, perhaps via the action of the 5-HT_{1A} autoreceptor. Taken together these findings suggest that DA establishes a motivational readiness to fight, whereas 5-HT may either inhibit or disinhibit aggressive behavior, thereby forbidding or permitting aggression but without directly affecting the motivational state. Surprisingly, in contrast to the conditioned changes in DA and 5-HT levels, the rats that fought showed only a slight increase of anticipation-related heart rate change in comparison to control mice that had not fought.

The feed-forward or proactive nature of preparatory aggressive arousal is also true for the way dogs cope with social stressors, explaining why the same aversive event might activate the HPA system or not depending on the degree of control or *power* (competence and confidence) that the dog perceives it has over the event. The foregoing findings support the idea that aggressive exchanges are under the regulatory influence of feed-forward conditioning effects. The evident adjustment and coordination of DA and 5-HT activity in anticipation of events, including the preparation of physiological states required to enable the animal to cope effectively with impending motivational demands strongly supports the notion that aggressive behavior can be regulated by control expectancies and emotional establishing oper-

ations integrated in the process of establishing an adaptive coping style. Psychological stressors perceived as uncontrollable challenges or threats exert a disorganizing effect (reactive coping style), whereas the same aversive motivation stimuli, when perceived as predictable and controllable, generate an organizing effect on behavior (adaptive coping style) precisely because adaptation is organizational and designed to learn and cope proactively with motivational challenges and threats rather than to merely react to them. These observations support the hypothesis that reward and punishment in association with positive and negative prediction error is critically dependent on the nucleus accumbens and its interconnectivity with the orbitofrontal cortex, amygdala, and VTA, neural processing networks that regulate the expression of motivated behavior in accord with proactive prediction-control expectancies and calibrated establishing operations.

Septal Distress, Relief, and Panic

The septum pellucidum is a limbic structure believed to perform a number of important functions in learning and the regulation of endocrine activity and emotion by virtue of its close relationship with the hippocampus and interconnectivity with the amygdala, the hypothalamus, the cingulate cortex, and the PAG. Reciprocal communication between the septum and the hippocampus occur via cholinergic tracts, with septal signals providing a pacemaker effect on hippocampal theta rhythms as well as serving to switch the hippocampus from an information processing mode to information collecting mode (Ikonen, 2001). The septum plays an important role in the process of forming expectancies about the timing and contingency of unconditioned stimuli (Garcia and Jaffard, 1996). Under the influence of aversive arousal septal stimulation appears to produce reward (relief), whereas under nonthreatening circumstances septal stimulation is hedonically neutral (Grauer and Thomas, 1982), suggesting that the septal-hippocampal connectivity may mediate passive avoidance, anxiety, and relief, whereas the central amygdala and the BNST are involved in the elaboration of fear and active avoidance. Medial septal lesions appear to significantly impair an animal's ability to respond adaptively to signals of punishment and nonreward (Gray, 1971). Impaired animals show deficits with respect to the inhibition of an activity once it has started, despite the presence of clear signals of punishment and nonreward. Unable to respond to stop signals, septal-impaired animals may nevertheless remain acutely aware that they are threatened by an impending loss or risk resulting from their failure to stop.

In response to emotional alarm or uncertainty, the central amygdala may activate anxiety-mediating excitatory pathways that reach the lateral septum via the paraventricular nucleus (PVN) and the BNST (Nail-Boucherie et al., 1998). Also, efferent AVP fibers project from the medial amygdala to the ventral hippocampus as well as the lateral septum directly and via the BNST (Caffe et al., 1987), suggesting that CRF and AVP (see DeVries et al. 1983) may synergistically interact in the lateral septum to mediate anxiety- and distress-related behavior. Interestingly, Thomas and colleagues (2003) have shown that CRF exerts a regulatory effect at the level of dorsal raphe nucleus over the release of 5-HT in the lateral septum, with low levels of CRF reducing septal 5-HT release and high levels of CRF increasing septal 5-HT release. This pattern of connectivity may promote a durable state of aversive arousal and punishment-resistant vigilance in response to a variety of acute psychological stressors requiring caution and persistence but not escalating into a state of reactive fear or anger. Significantly, paroxetine exerts an inhibitory effect over the release of 5-HT via the 5-HT_{1B} autoreceptor, an effect that takes place most prominently in the ventral hippocampus (Gardier et al., 2003). 5-HT also appears to modulate cholinergic transmission via postsynaptic 5-HT_{1B} receptors expressed on the terminals of cholinergic neurons within the hippocampus. Fish and colleagues (2000) have shown that 5-HT_{1B} agonists mediate a suppressive effect over mouse distress vocalization to maternal separation (Fish et al., 2000), suggesting a possible mechanism for the bene-

ficial effects of paroxetine for the control of separation distress and panic. Consistent with this hypothesis, nicotine, a cholinergic agonist, has also been shown to decrease separation distress vocalizations in chicks, whereas the antimuscarinic scopolamine increases distress vocalizations (Sahley et al., 1983). Further, the electrical stimulation of the ventral septum produces a high level of separation-distress vocalizations, as does stimulating the BNST (Panksepp, 1998). Recently, Degroot and colleagues (2004) have reported that the septal-hippocampal system plays a prominent role in the modulation of different anxiety states via glutaminergic, GABAergic, and cholinergic pathways. Finally, GABAergic plasticity at the level of the septum determines how animals cope with inescapable stressors, with the stress-mediated downregulation of septal $GABA_B$ receptors appearing to exert a protective influence against learned helplessness (Kram et al., 2000). In addition to the panic occurring in association with separation distress, the lateral septum and BNST may also play a role in mediating the panic associated with certain forms of aggression expressed in association with a reactive coping style (see Koolhaas et al., 1998).

The panic and persistence associated with separation distress is consistent with what one would expect to occur in association with faulty septal-hippocampal processing, whereby the dog appears to become "obsessively" fixated on an expectation of impending relief, despite foreknowing (signals of nonreward) that the owner will not likely come home any time soon, consistent with impairments affecting passive avoidance learning. The precise etiology of such problems is unknown, however, it is reasonable to suggest that social ambivalence and entrapment occurring in association with insecure or nervous attachments may promote complex disturbances disrupting glutaminergic, GABAergic, opioidergic, or cholinergic transmission and that these dynamics might produce a detrimental imbalance at the level of the septum and other limbic areas conducive to separation distress. The involvement of these systems in the mediation of separation distress may help to explain why people often increase their consumption alchohol, sugar, sweet and fatty dairy products (e.g., ice cream), and tobacco at times involving social loss and separation. The consumption of sugar, for example, may produce a self-medicating effect via a glucose-mediated reduction of opioid restraint over cholingergic activity, whereas nicotine consumption may alter activity in cholinergic-dopaminergic pathways. Ragozzino and colleagues (1992) found that passive avoidance was impaired when morphine was injected into the medial septum, whereas the administration of glucose reversed the deficit. Under the influence of an insecure attachment heightened oxytocin activity may mediate a sensitization to opioid and DA activity, making the dog vulnerable to opiate-like addiction and withdrawal symptoms when the insecure social attachment object maintaining DA, opioid, and oxytocin levels is withdrawn. Interestingly, clomipramine, a drug commonly used to treat separation-related problems, reduces central opioid levels, down regulates opioid-binding sites, and attenuates morphine-induced analgesia. In addition, among humans, clomipramine has been shown to increase oxytocin and to decrease CRF levels in the cerebral spinal fluid (CSF) (McDougle et al., 1999), perhaps contributing to the stabilizing effect that the medication appears to exert over canine separation distress.

The finding that glucose interacts with opioids in a function-restoring fashion, suggests that at least in some cases of separation distress, a sugar pill may be more than just a placebo. Also, given the apparent attenuating effects of nicotine on separation distress, it would be interesting to learn whether there is any discernable relationship between cigarette smoking in households with dogs and the risk of separation-related problems. Whether feeding the dog sweet-flavored treats or giving it toys that have been coated with a sweet solution would have any benefit on separation-related problems is unknown but such research may be interesting to pursue, since the dog definitely has a sweet tooth (Ferrell, 1984). Among human infants undergoing painful medical procedures, sucrose and non-sucrose sweeteners have been shown to dimin-

ish signs of pain for up to 5 minutes, with peak effects observed at 2 minutes after ingestion (Blass and Shah, 1995). These findings suggest the obvious possibility that similar benefits might be obtained in the case of puppies and dogs receiving vaccination shots or undergoing painful grooming procedures (e.g. cleaning ears). In addition to analgesic effects, among rat pups that have been separated from their mother, ingestion of sucrose also produces a calming effect in the distressed infant (Blass et al., 1987). Milk also appears to produce similar effects among infant rats (Blass and Fitzgerald, 1988), apparently not as result of lactose (Blass and Shide, 1994), but perhaps due to the casomorphine contained in milk casein or as the result of milk fat. The calming effect of sucrose on separation distress is robust, reducing distress vocalizations by 50% (Blass and Shide, 1994). Interestingly, with respect to the cholinergic-opioid hypothesis outlined above, the analgesic effect of sweet substances appears to be mediated by nicotinic cholinergic receptors (Irusta et al., 2001). Casual observations by the author indicate that small amounts of whipped cream or soft cheese delivered from a pressurized can do seem to mediate a transient comforting effect. The use of food items may provide benefits in the case of puppies that are overly resentful or reactive to routine veterinary or grooming procedures. In any case, given the reports from human and animal studies of an analgesic effect, some investigation is warranted to explore whether food items such as whipped cream or soft cheese might be useful for reducing the discomfort and fear associated with veterinary examinations and treatments. The first visit is the most critical since those impressions are extremely durable. Using a combination of food, odors, petting/massage, and toys might help to reduce the risk of the dog forming lasting aversive associations linked to veterinary visits, while at the same time promoting positive expectations.

Periaqueductal Gray and Autoprotective Adjustments to Social Stressors

Social disengagement, confrontation, and aversive communication systems appear to converge subcortically at the level of the PAG (periaqueductal gray) (Keay and Bandler, 2001). The PAG projects to the nucleus ambiguous (Farkas et al., 1997) where it may increase heart rate and blood pressure and participate in the expression of threat displays (e.g. direct stare, snarling, ears forward, and growling) (lateral PAG) or decrease heart rate and blood pressure and contribute to the expression of defeat and appeasement displays (e.g., averted eye contact, head down, ears pinned back, and yelping) (ventrolateral PAG). Active and passive coping reactions in response to threats are under the regulatory influence of both cortical and limbic pathways (e.g., amygdala, hippocampus, and hypothalamus) (see *Stress-related Potentiation of the Flight-Fight System* in Chapter 6). These reactions include emotional vocalizations expressing distress, discomfort, and alarm/threats, social communication that appears to be mediated by the PAG and vocal-motor nuclei located in the brainstem. The strong connectivity between the prefrontal cortex and the PAG emphasizes the role of psychological stressors (e.g., violations of prediction-control expectancies) on the development of fear and aggression problems. PAG flight-or-fight adjustments appear to be under the modulatory control of reciprocal inhibition, that is, when PAG flight networks are activated PAG fight programs may be actively restrained while a converse effect appears to occur when the fight network is activated (Jansen et al., 1998). The rostral aspects of the dorsolateral (dlPAG) and lateral (lPAG) columns of the PAG mediate confrontational threat and attack (anger) (fight system), while the caudal aspect of the dlPAG and lPAG mediate the mobilization of defensive escape (fear) (flight system). The rostral portion of the lPAG receives ascending somatosensory input originating from the face and forelimbs, whereas the caudal portion of the lPAG receives afferent input from the lower portion of the body. This organization of somatosensory organization suggests that frontal threats are more likely to evoke anger and offensive aggression than threats coming from behind, which are more likely to evoke fear and defensive adjustments. The ventrolat-

eral PAG (vlPAG) mediates opioid-mediated analgesia, bradycardia and hypotension, and tonic immobilization, suggesting that the vlPAG plays a role in facilitating the aggression-suppressing effects of repeated social defeat (Depaulis et al., 1994).

When the dog is challenged or threatened in a serious way a pathway linking the medial amygdala, the bed nucleus of the stria terminalis (BNST) (an area that may promote intensified vigilance at such times), and the medial hypothalamus may be activated to mobilize an avalanche of neurophysiological activity at the level of the PAG that might promote catastrophic autoprotective adjustments. Both the rostral and caudal aspects of the lPAG and the dlPAG produce tachycardia and hypertension but do so in association with different patterns of vasodilation and vasoconstriction. Defensive arousal associated with the caudal lPAG results in a diversion of blood from the head and viscera to the skeletal muscle. In contrast, offensive arousal associated with the rostral dlPAG result in an increased heart rate and blood pressure associated with a diversion of blood from the skeletal muscles and viscera to the head via increased extracranial blood flow. The vasodilation and increased blood flow associated with dlPAG offensive arousal may explain the reddish glow that dogs show immediately before launching into an attack. Unlike the lPAG, the dlPAG column receives no significant spinal, trigeminal, or medullary inputs, but is strongly enervated by descending inputs from the right mPFC. These mPFC efferent pathways also target the anterior and ventromedial hypothalamus, a pattern of connectivity that suggests that the mPFC in coordination with the hypothalamus serves to modulate the expression of aggression and escape behavior (Keay and Bandler, 2001). The lPAG receives strong cortical enervation from the cingulate area (An et al., 1998), perhaps mediating aversive state arousal and behavioral activation associated with the detection of social conflict and loss. Kyuhou and Gemba (1998) found that the area of the guinea pig PAG that evokes separation-distress vocalizations, receives "massive input" from the ACC, lending support to a possible linkage between separation distress/panic and the PAG.

PART 2: BONDING THEORY

Ontogeny, Coping, and Social Behavior

The disorganizing influence of runaway allostatic load and the integration of maladaptive behavioral phenotypes may be initiated or prefigured early in a dog's ontogeny. Dogs exposed to adverse prenatal and postnatal stress, perinatal trauma, or maternal maltreatment may show a more dramatic and exaggerated allostatic response and tendency to integrate adaptation-impairing load in response to stressors than dogs exposed to more favorable ontogenetic programming early in life. The type, amount, and timing of early stress may profoundly affect the expression and functionality of PSMs and the ability of a dog to adjust in a functionally coordinated way. Developmental programming and insults that cause modal disturbances affecting sensorimotor processing (preattentive and preemptive arousal) and various motivational and motor systems integrating drive and behavioral output may impair a dog's ability to achieve coherent and stable adjustments.

In addition to psychological stressors, damage associated with infectious disease and environmental toxins have been implicated in etiology of adult and childhood behavioral disorders. Mothers exposed to viral infections early in the gestation period may transmit pathological antibodies or cytokines across the placenta that produce lasting harmful effects. Rat mothers, for example, infected with influenza virus during day 9 of gestation showed alterations in exploratory activity, including increased aversion toward novelty together with deficits affecting prepulse inhibition in response to auditory startle (Shi et al., 2003). Brown and colleagues (2004) have reported that babies born to mothers exposed to influenza during the first trimester showed a sevenfold increase in risk for developing schizophrenia in adulthood. Since the influenza virus only rarely crosses the placenta, the researchers implicate maternal immunoglobulin G antibodies activating fetal

brain antigens or a virus-induced excess of maternal cytokines. Infant exposure to environmental toxins has been implicated in the expression of a wide spectrum of behavioral disorders, including attention-deficit hyperactivity disorder, retardation, and autism (Zoeller et al., 2002; Colburn, 2004). The effects of thyroid are pervasive and time dependent, affecting the organization of neural tissue and connectivity via myelination and synaptogenesis. Thyroid plays a significant role in the organization of the glucocorticoid, cholinergic, and serotonergic systems and the structural development of the cortex, basal forebrain, cerebellum, hypothalamus, and hippocampus (Meaney et al., 2000; Thompson and Potter, 2000; Smith et al., 2002; Zoeller et al., 2002). The prenatal role of thyroid in the development of neuronal systems mediating the organization of social coping styles emphasizes the importance of fetal thyroid balance. Exposure to a variety of common medications and cytokine-producing vaccinations during the first trimester of gestation may exert far-reaching effects on a progeny's behavioral adaptability in adulthood (see *Antistress Neurobiology, Maternal Care, and Coping Style* in Chapter 8 and *Immune Stress and Cytokines* in Chapter 6).

Although PSMs and the various interconnected modal networks and motor programs subserving their development and expression may remain relatively quiescent and unintrusive under the influence of minimal change and stress, dormant dysfunctional modes may be activated later in life under the influence of psychological stressors or in association with epigenetic shifts heralding major developmental transitions (e.g., puberty and adulthood). These late epigenetic elaborations and patches may be particularly vulnerable to disorganization and instability. Under the influence of aberrant polymorphisms or stressors, problematic PSMs may integrate at an age-inappropriate time and thereafter exert adverse epigenetic changes to modal drive networks and emotional command systems. For example, paedomorphic behavioral phenotypes may be the result of such developmental delays and shifts in organization serving to prolong youthful sociability and playfulness, with many dogs appearing to operate under a predominant play drive. Late developmental epigenetic elaborations or patches that add on to or activate modal networks and motor programs organized early in life but left in a dormant state (e.g., the gender dimorphic effects of perinatal sex hormones) are prone to mobilize instability and allostatic load when mediating disruptive social dynamics associated with social ambivalence and entrapment. Accordingly, dormant dysfunctional PSMs activated while adult sociosexual phenotypes are being elaborated may be particularly sensitive to conflictive social dynamics, dispersive tensions, and show an increased vulnerability for the expression of reactive and impulsive behavior.

The dysfunctional mode and subservient modal networks may become progressively autonomous and disruptive while degrading or abolishing executive control and fostering a reactive coping style associated with accumulating allostatic load, ambivalence, and entrapment. Under the influence of social and environmental stressors perceived as inescapable (entrapment), a dog may attempt to adjust by retracting the SES while disengaging executive attentional resources, giving rise to dispersive tensions (e.g., resentment, irritability, and intolerance) and autoprotective dynamics, on the one hand, and mediating persistent anxiety, autonomic deregulation, and impairment of the dog's ability to cancel/inhibit or activate/disinhibit autonomic and emotional processing appropriately in coordination with purposive drive and functionally appropriate behavior (see *Breed and Individual Difference and Reactive/Impulsive Behavior*).

Prenatal Stress: Born to Flee or to Bite?

The enduring developmental effects of prenatal stress have been traced to various changes in all major neurotransmitter systems (Weinstock, 1997). In addition to altering NE and serotonin (5-HT) activity, prenatal stress reduces DA turnover in the nucleus accumbens while increasing DA turnover in the PFC. Chronically elevated DA activity in the PFC may disrupt executive attention and impulse-control functions (see *Startle and Fear Circuits* in Chapter 3), whereas a reduc-

tion in DA turnover in the mesolimbic system may diminish an animal's ability to produce reward and mobilize reward-dependent active modal strategies (e.g., exploratory behavior and social engagement). In fact, animals exposed to prenatal stress have been shown to exhibit a diminished responsiveness to reward (Matthews et al., 1996; Matthews and Robbins, 2003). The intrinsic reward that mediates play appears to depend on a balance of DA and opioid activity, whereas acetylcholine and NE appear to be involved in the cognitive, exploratory, attentional, and arousal aspects of play behavior (Vanderschuren et al., 1997; Panksepp, 1998).

Developmental perturbations of the DA reward system would likely disrupt a young dog's ability to refine control modules, thereby adversely influencing its ability to integrate adaptive behavior. Such prenatal disturbances affecting reward processing suggest an explanation for the *reward resistance* exhibited by some dogs to behavior-therapy procedures dependent on the conditioning of reward signals. The tendency of unstable introverts to show a heightened sensitivity to signals of punishment and a reduced responsiveness to signals of reward is consistent with a prenatal origin of such temperament differences as well as the anxious/irritable dysthymia exhibited by such dogs. In addition to an increased sensitivity to stimuli producing anxiety and a blunted responsiveness to reward, prenatal exposure to maternal anxiety and anger may program neurobiological changes that might confer an increased risk for developing behavior problems associated with anger and impulsivity in adulthood. For example, babies born to high-anxiety, angry, and depressed mothers show parallel biochemistry profiles (low DA and 5-HT levels), decreased vagal tone, and right hemisphere electroencephalographic asymmetry (Field et al., 2003), perhaps predisposing them to integrate similar mood and behavioral propensities.

Postnatal Handling: Protective and Destructive Influences

Postnatal stimulation may accentuate, diminish, or reverse the adverse effects of prenatal stress. Whereas long periods of separation from the mother can result in HPA-axis disturbances in adult rats, briefer periods of separation tend to produce a moderating effect on emotional reactivity and HPA-axis activity. Adverse maternal separation stress produces a downregulation of glucocorticoid-binding sites in the hippocampus, as well as increases hypothalamic CRF mRNA expression. This combination of neural changes may result in an adult animal that is stress prone, showing a greater vulnerability to the adverse effects of chronic environmental and psychological stressors via impaired hippocampal negative-feedback control over CRF release and increased CRF activity. Although the stress-mediated facilitation of CRF gene expression exerts highly durable and perhaps irreversible changes on the CRF system, the brain shows remarkable capabilities to make compensatory adjustments. For example, among rats exposed to harmful maternal separation, social and environmental enrichment procedures ameliorate the adverse effects of early stress on HPA-axis activity and fearful responses to psychological stressors (Francis et al., 2002).

The critical factor affecting the long-term effects of early stress probably depends on the quality of maternal care received by an infant. Several studies have shown that it is not the *stress* produced by separating an infant from its mother or exposure to environmental insults, but rather the benefits are due to subsequent changes in the mother's caregiving behavior when the infant is returned to the nest (see *Antistress Neurobiology, Maternal Care, and Coping Style* in Chapter 8). Maternal caregiving behavior appears to be invigorated by the pup's absence from the nest and upon reunion the separated infant becomes the object of intensified exploratory interest, licking, and other maternal contact behaviors. Among rats, adoptive mothers are typically more attentive to adopted pups and tend to give them more grooming and licking than provided by natural mothers. Maccari and colleagues (1995) have shown that the increased care provided by adoptive mothers appears to reverse the adverse behavioral effects of prenatal stress on HPA-axis activity.

An infant's ability to cope with stress in adulthood appears to be mediated by an antistress system that is integrated by the central release of oxytocin in response to maternal licking and other caregiving activities. Repetitive stroking and other forms of stimulation similar in effect to maternal care and grooming have been shown to induce oxytocin release and to exert a protective influence or to reverse the effects of prenatal stress on developmental disorders in adult animals (Weinstock, 2002) (see *Handling and Gentling* in Chapter 4). The obvious implication of these various findings is that the amount and quality of maternal attention and care received by the infant exert a significant programming effect on adult coping styles (see *Ontogeny and Reactive Behavior* in Chapter 8).

Ontogeny, Olfactory Cortex, Attunement Nodes, Engrams, and Networks

During the first 2 weeks of life, a puppy is adapted to an off-line state dedicated primarily to nursing and sleeping (Fox and Stanton, 1967) adjusting as needed to internal and external stressors by means of an array of sensorimotor reflexes. Sensory inputs are reduced to a minimum with the eyes and ears remaining closed, but as these sensory channels open between weeks 2 and 3, respectively, a dog becomes increasingly active and interactive. By the time a dog reaches week 3, it already shows a strong preference for the smell of kin bedding (Mekosh-Rosenbaum et al., 1994) consistent with the existence of a motivated preference and attachment. At weeks 4 1/2 to 5 1/2 (Hepper, 1986), they orient, presumably using both auditory and visual channels (although auditory information may play a subordinate role), and ambulate into the proximity of familiar siblings and avoid other puppies of a similar age, breed, and sex. The olfactory memories and preferences integrated during this time appear to degrade with respect to the recognition of separated siblings but remains intact with respect to the reciprocal recognition shown mothers and offspring after 2 years of separation (Hepper, 1994). In addition to confirming these earlier studies, Gillis and colleagues (1999) have demonstrated that dogs not only recognize their mother but also recognize the scent of the breeder well into adulthood and probably for much of their lives (Appel et al., 1999).

With the onset of the socialization period at week 3, a rapid integration of corticohypothalamic networks and exchange-mediated autonomic attunement nodes emerges to regulate drive and emotion and to guide sympathovagal tone toward a state of balance conducive to alertness and social engagement (see *Socialization: Learning to Relate and Communicate* in Volume 1, Chapter 2). During these early weeks, social expectancies, autonomic attunement, and play facilitate increased social attraction and awareness. A puppy's ability to learn appears to reach a high level by weeks 7 and 8, abilities that may already start declining after week 16 (see *Learning and Trainability* in Volume 1, Chapter 2).

Weaning and Parent-Offspring Conflict

According to an influential theory of parental investment (PI) proposed by Trivers (1972), both parents invest in the care of offspring, but the PI of males is typically much less than that of females. In some species, such as dogs, the male PI consists only of donating sperm, whereas other mammalian males contribute more equitable investments to the care of the young. The amount of PI given by the mother and father appears to exert a profound influence on the reproductive relationship, the social organization of the group, and the quality of interaction among members of the group. Besides nurturance, a significant part of PI involves protection. Among wolves, mothers and fathers share a major investment in the care and protection of the young (Mech, 2000). They form lasting pair bonds, show evidence of a division of labor, and organize relatively stable family groups. The mother wolf suckles and cares for the young and protects the denning area, whereas the father appears to play a greater role in the defense of the home territory while provisioning the mother and young with food. In contrast, males in animal societies where they contribute minimal PI to their offspring may nevertheless contribute strongly to the gene

pool to the extent that they can compete successfully with other males seeking females to fertilize. In such animal groups, intermale competition may be more prominent, necessitating a variety of biological (e.g., endocrine control of agonistic thresholds) and social adaptations (e.g., dominance hierarchies) to moderate competitive tensions.

The weaning process exhibited by wolf mothers appears to be relatively peaceful, at least when adequate amounts of alternative food are available to feed the young. Packard and colleagues (1992) observed only one occasion prior to week 7 in which the mother terminated a nursing bout by muzzling a pup. From week 6 onward, however, they observed a trend toward more frequent mother-initiated terminations of nursing bouts and infant-directed agonism, culminating in weeks 8 and 9, when the mother terminates 80% of the nursing bouts by agonistic means. The use of muzzling to control nursing activity was usually associated with signs of discomfort on the mother's part (wincing). The wincing action itself acquired the ability to interrupt nursing. After the mother winced or muzzled them, the pups stopped nursing and did not persist.

Under domestic conditions, the mother and the breeder contribute the primary sources of PI in the care of puppies. In addition to giving the mother emotional support, the breeder assists the dam by feeding the puppies solid food or by confining the puppies or by helping the mother stay out of the offsprings' reach, perhaps by providing a ledge or other place for the mother to retreat. In the early stages of nursing, the mother appears to derive considerable gratification from the contact with her offspring (Korda, 1974), initiating nursing bouts and spending large amounts of time caring for them (Rheingold, 1963). Licking bouts are most frequent and lengthy during the first 2 weeks postpartum. As the mother's willingness to nurse declines toward week 4, there is an increase in offspring-initiated approaches and nursing bouts, which may rapidly exceed the mother's optimum PI and require the breeder's intervention to control. In addition to the food given to the puppies by the breeder, some canine mothers may regurgitate. Regurgitation serves to transition the puppy from the ingestion of the preferred mother's milk to the search for solid food (James, 1960; Malm, 1995). Martins (1949) observed that the appearance of regurgitation is closely associated with the decline in lactation and continues only a few days after weaning is complete, whereas Korda (1974) found that regurgitation routinely continued long after puppies were able to eat solid food—conflicting findings that suggest the existence of a high degree of individual variability affecting the habit. Domestic male dogs can be induced to regurgitate in response to et-epimeletic displays if they are confined in close proximity with puppies (Korda, 1974), but the tendency to provision food to offspring appears to be generally atrophied in male dogs. Feral male dogs may stay with the mother, sleep nearby, and even play with the puppies but do not provide the young with food (Macdonald and Carr, 1995). This lack of PI by male dogs is a peculiarity of domestication and in sharp contrast to the behavior of wild canids.

During weaning, the competent mother appears to calm the puppy with affectionate tactile stimulation, complementing the more energetic, playful, and competitive exchanges among littermates. Gently muzzled puppies may be transitioned to receive a sustained licking or nibbling bout, maternal activities that they appear to enjoy by rolling on their side or back, laying still, and often closing their eyes. Puppies may show signs of growing sibling agonism during this period of transition, but they rarely attempt to provoke such interaction with the mother. Often by means of the mildest assertions of maternal force, a puppy defers or walks away—a response that may be followed by the mother going to the puppy and intermittently mouthing or licking around the scruff of the neck. The mother appears to actively mediate a reconciliation process with the discouraged youngster. Contingent assertions of power, affectionate reconciliation, and periodic absences serve to reduce undesirable behavior while at the same time stimulating emotional establishing operations that prime conflict-resolving adjustments and compromise. The assertion of

maternal power mediates various passive modal activities (e.g., hesitating, waiting, and submissive ritualizing) that are valuable for promoting impulse control and cooperative behavior.

The conflictive dynamics of exchange between the mother and puppy appear to promote an emergent coping style consistent with many of Trivers' predictions regarding parent-offspring conflict (Trivers, 1974) (see *Parent-Offspring Conflict and Interactive Conflict* in Chapter 8). The puppy's efforts to get care in excess of the mother's parental investment, while avoiding punishment (e.g., loss of care and risk of physical restraint), provides a framework of positive and negative incentives that may point to the origin of propensities toward interactive conflict and exploitive exchange, on the one hand, or interactive harmony and fair exchange, on the other.

Mothers pushed beyond the limits of their PI may become increasingly reactive and abusive toward their young (see *Maternal Mistreatment* in Chapter 8). In a study by Scott and Fuller (1965), canine mothers and offspring were kept together until week 10 under relatively austere conditions of close confinement. This rearing practice may have been highly stressful for both mothers and offspring, perhaps accentuating the effects of prenatal stress on the emotional reactivity of the puppies and explaining the high level of agitation and aggression exhibited by mothers toward offspring (Rheingold, 1963). On the other hand, removing puppies too early from the mother may result in lasting impairments diminishing the offsprings' ability to achieve autonomic balance.

In any case, disruptive influences stemming from maternal mistreatment may exert profound and lasting adverse effects on a dog's ability to cope adaptively with complex social demands. However, the same flexibility that makes a puppy vulnerable to destructive influences also makes it highly resilient and responsive to protective influences, perhaps helping to explain the apparent lack of significant maternal effects shown by German shepherd dogs in a recent study performed by Strandberg and colleagues (2004). Whereas exposure to inescapable aversive stimulation shortly after weaning profoundly disturbs adult escape behavior, exposure to controllable aversive events early in life appears to have an immunizing effect against the adverse effects of inescapable aversive events in adulthood (Hannum et al., 1976). How a puppy is treated in the home ultimately seals its fate by either accentuating problematic aspects of developmental programming or by providing it with social and environmental conditions that promote compensatory adjustments conducive to an adaptive coping style and allostasis—*stability through change*.

Attunement, Attachment, and the Human-Dog Bond

According to the affect-attunement hypothesis, dogs and people relate by feeling their way through exchanges and by shifting arousal and output to match the emotional intensity, duration, and shape of the partner's reciprocating actions. The mutual appreciation or sharing of attention, intention, and affective states is marked by the emergence of an interactive attentional nexus and an allocentric relational space within which human and canine partners build complex predictive relations that serve to synchronize arousal and affective states. From a foundation of care relations mediating autonomic attunement, the dog shows an increasing appetite for socially mediated and shared experiences with others. When facing problems or circumstances evincing difficulty or uncertainty, dogs, like infants studied by Stern (1985), may look toward the social partner for "affective content, essentially to see what they should feel, to get a second appraisal to help resolve their uncertainty" (132). The dog's ability to grab and steer the human partner's attention to the location of out-of-reach toys or food reflects a capacity for relating to the other allocentrically, indicating the operation of a cognitive functions that enable the dog to appreciate the perspective of the partner relative to objects of interest to the dog. Affect attunement is commonplace in the interaction between people and dogs (Finck, 1993), especially in the context of caregiving and play exchanges. Affect attunement occurs

when a partner's actions convey the feelings of a shared affective state, and it serves to focus attention on the "quality of feeling" that underlies expressive behavior: "Imitation renders form; attunement renders feeling" (Stern 1985:142).

Affect attunement gives social interaction a quality of sharing an experience and existence that stands outside of oneself. The personal nature of attachment entails that social transactions be tagged with unique social and contextual identifiers. Only exchanges with a specific individual can be encoded and stored in that person's social account, so to speak. Attunement imbues attachment relations with an implication of *responsibility* to the other, as one might feel responsible for how the dog feels and then adjust exchanges to compensate, as needed, to produce affective shifts conducive to a more desirable state, that is, to protect and care for it. As such, the affective changes associated with attunement dynamics that promote social and place attachments have the ontic property of belonging to the other who has an *identity*. To attach is to belong and incur an obligation to care for and to protect the interests of the attachment partner (loyalty). These attachment and attunement dynamics set the framework for many of the benefits of dog ownership as well as potential adjustment problems. Interestingly, when reminiscing over a previous family dog, many dog owners are apt to tell stories that illustrate the belongingness qualities of the attachment by referring to extraordinary caregiving behavior, fidelity, and heroic stories involving the protection of children.

As the result of the autonomic and affective attunement associated with the integration of secure attachments, a bond of belongingness is formed that links the dog and family together to *share* a secure living space held in a common trust (see *Social Spaces, Frames, and Zones* in Chapter 8). Secure social and place attachments shape a dog's identity into one who belongs as an object of care and protection. Social exchanges operating under the modulation of competent attunement serve to anticipate and match autonomic arousal to prediction-control expectancies, calibrated emotional establishing operations, and goal-directed actions (control modules) that enable dogs to accumulate hedonic value in support of optimistic mood, social attraction, cooperation, play, and the integration of an adaptive coping style.

Opportunity with Limit

Attaining cynopraxic objectives depends on decisive action at the right time (*kairos*). In dog training, the coordination, selection, and timing of social exchanges are critical for success. The notion of kairos goes to the inner nature of such intuitive action and timely exchange. The word *kairos* was used in a variety of ways by ancient Greeks to describe timely action or opportunity. White (1987) suggests that the term was used to refer to the brief moment allowed for a weaver to pass a thread through a gap opened momentarily in the warp of a cloth being woven. In the *Odyssey*, Homer combines this early meaning of kairos with a manipulation of time used by Penelope to postpone the time agreed by her to decide and choose among the suitors. Penelope promised the suitors that as soon as she had finished a shroud that she was weaving for Odysseus' father that she would choose a new husband. But the promise was only a ruse to gain time, since at night she undid the work she accomplished during the day. A symbolic implication of her trick is that placing a thread through the kairos advanced time and pulling the thread out again held time back, at least with respect to the timing of the moment for her decision. Eventually, her subterfuge was discovered and the suitors demanded that she now decide and choose. Here, a second meaning of kairos enters the story, bringing the separated husband and wife closer together and setting the occasion for a decisive event. Instead of acquiescing to the suitors' demand, Penelope devised a contest for them to decide the matter of her hand. The challenge required that the winner string Odysseus' horned bow and then shoot an arrow through the hub of 12 axes aligned in a row. Like the passage of a thread through the warp of a cloth, the pas-

sage of an arrow through the opening of the hub of axes aligned in a row is also referred to as kairos (White, 1987), thus linking the two meanings in the critical moment when Odysseus, disguised as a beggar, takes the bow in hand and asserts his status and real identity as husband by stringing the bow and sending the arrow through the kairos. Unbeknownst to her at the time, Penelope's stalling had set the occasion of the contest in synchrony with the return of Odysseus and all that would follow. Having revealed his identity as husband, Odysseus is now united with Telemachus, as father and son, to take the moment of surprise to mete out justice upon the corrupt band of suitors who had invaded his home.

These two meanings of kairos derived from weaving and archery combine a balance of feminine and masculine energy (work or effort) to effect change and restore order and stability to a state of disorder by means of timely action. Thus, the ideal cynopraxic trainer combines the steady patience and intuitive vision of the weaver, on the one hand, and the mental steadiness and strength of the archer, on the other, to act decisively at the best opportunity. The opportune moment is not found by means of spontaneous opportunity-taking efforts, but by acting in accord with limit, by setting the stage, and by letting the opportune moment happen, as exemplified by Penelope's strategic stalling and the circumstances of the contest that she set for the suitors that enabled Odysseus to reclaim his identity heroically as husband and father.

Hitting and Missing the Mark

Social interaction is significantly complicated by the mutual control that social partners have over the moment of exchange and the circumstances surrounding exchange. As a result, social exchange is vulnerable to *tricks* of timing and other efforts used by interacting partners to make exchanges happen in ways that allow them to take an advantage or to engage in preemptive social strategies aimed at protecting themselves against the loss and risk associated with exploitive interaction. The result of such interactive subterfuge is mistrust and misattunement, that is, putting the other out of step by concealment and deception, much as Penelope manipulated the exploitive and obtrusive suitors by her clever ruse. The process of adaptive optimization depends on the reciprocal give and take of opportune moments for attaining reward while staying within fair-play limits to keep the exchange going and thus opening a *social space* of interactive possibility expanding under the pressure of complementary power and freedom incentives. Symbolically, the forces at both ends of the bow must be applied in equal measure to send the arrow straight to the mark. For social exchanges to resonate autonomic nodes conducive to attunement and interactive harmony, they need to be perceived as fair and rewarding. Just as the archer must master the art of letting the bowstring jump with a surprise from the fingers, there is a surprise element that enables social exchanges to *hit the mark* (tychon); that is, social exchanges need to be made at a propitious moment with an element of surprise to arouse interest and to promote learning.

The social skills and confidence acquired in resolving interactive conflict naturally involve attunement dynamics compatible with mutual appreciation and interactive harmony. With improving social skills and confidence, a dog is empowered to pursue a wider range of cooperative projects with its owner in pursuit of freedom incentives. Social exchanges that hit the mark promote enhanced awareness (attentive mindfulness), secure attachments, mutual appreciation, and interactive harmony. Exchanges that miss the mark (hamartia) promote an imbalance of *opportunity without limit* that generates increasing disorder and impulsivity (big-bang effect), whereas exchanges promoting an imbalance of *limit without opportunity* are prone to mediate behavioral reactivity and rigid inhibition (black-hole effect). A persistent failure to engage in fair exchange elevates social distress and promotes conflict monitoring, incompetence, instability, and a state of persistent autonomic misattunement. The

resultant reactive coping style is hypothesized to underlie a wide gamut of social adjustment problems.

BIG BANGS AND BLACK HOLES: EXTRAVERSION, INTROVERSION, AND DISORGANIZING LOAD

Behavioral adjustments may either hit the mark or miss it. One performing actions that hit the mark depends on experience to learn the most opportune moments (occasion-setting criteria) to act and what to expect as the result of actions, and to tune energy expenditures and preparatory arousal to act in accord with those expectancies. Behavioral adjustments are said to *hit the mark* when expectancies, preparatory arousal, and action modes promote social exchanges conducive to reward, autonomic attunement, secure attachments, and an adaptive coping style. On the other hand, a failure to attune arousal and action readiness in accord with reliable predictive information, causing a dog to motivationally overshoot or undershoot the mark or miss the right opportunities to act, promotes behavioral adjustments that *miss the mark*. Social exchanges that consistently overshoot the mark because of a lack of predictive modulation regulating excitatory arousal and action readiness tend to promote an externalizing (approach) imbalance in the direction of hyperactivity, novelty seeking, and exploitive social interaction. At the other extreme, dogs lacking predictive modulation over inhibitory processes may miss the mark by consistently undershooting the mark because of an internalizing imbalance in the direction of behavioral inhibition, social avoidance, and withdrawal. These inhibited types show caution in response to novelty and an active intolerance for situations that require risk taking. Behavioral adjustments that persistently undershoot or overshoot the mark promote autonomic misattunement and insecure or nervous attachments associated with a reactive coping style.

Theoretically, the viability of an adaptive behavioral system is determined by its potential for correspondence, complexity, and flexibility; that is, its ability to achieve a balance between order and variety while constructing a coherent reality organized to cope with uncertainty and change. Behavior-organizing constraints that limit opportunity and variety are hypothesized to result in a loss of adaptive capacity or *adaptability*. A preoccupation with the familiar and the safe renders a dog vulnerable to the pull of axipetal load. Conversely, systems that fail to limit variety and opportunity tend to become increasing energetic, expansive, and disorderly, showing a preoccupation with novelty and stimulus change (uncertainty) under the push of axifugal load. Where axipetal load is associated with excessive energy loss (drain), axifugal load is associated with excessive energy gain (strain). The drain and strain of load impairs a dog's ability to construct a viable *umwelt* and cope proactively with change. These opposite forms of instability represent the extreme ends of allostatic load, whereby energy is tied up in processes that prevent the dog from organizing predictive relations and change conducive to stability.

Axipetal load mediating unstable introversion (high-approach/low-withdrawal thresholds) appears to reduce prediction error gradually to a negative significance—a negativity bias that degrades a dog's ability to cope with loss and risk proactively. These extreme features of unstable introversion roughly correspond to what Pavlov referred to as the *melancholic* (m) type. An m-type dog treats novel and unexpected change as inherently threatening. As a result, the ability of affected dogs to encode and invest novel social exchange with hedonic value is significantly curtailed. Such dogs only slowly habituate to social novelty and tend toward social inhibition and withdrawal. The effect of internalizing load is akin to an affective black hole, where social space is narrowed and closed under the influence of increasing passive modal activity. Instead of searching for reward opportunities, unstable introverts turn attentional resources toward a heighten vigilance for signals of loss and risk in association with an active disinterest in exploratory activity. The adaptive strength of negative prediction error to conserve energy and to limit loss and risk becomes a significant hindrance when

isolated from the balancing influence of cortical reward and active modal activity. As a result, affected dogs may become increasingly preoccupied with conflict monitoring, compulsive rituals, and autoprotective concerns (see *Attention, Dopamine, and Reward* in Chapter 5).

By contrast, unstable extraverts appear to operate under an opposite bias toward novelty and stimulus change. These dogs, corresponding to Pavlov's *choleric* (c) type, tend to treat stimulus change and novelty as intrinsically rewarding, regardless of predictive significance causing them to rapidly accumulate energy gains that produce a state of externalizing load analogous to the big bang, whereby an enormous amount of energy is expended in the vain pursuit of reward signals. Axifugal load accelerates feed-forward processing in the direction of extraversion (low-approach/high-withdrawal thresholds), simultaneously flattening and stretching out space and reducing prediction error to a positive significance. The stretching out of axifugal social space is correlated with a decline in awareness and attentional tone, behavioral disorganization, and dispersive independence (autonomy). The novelty-seeking efforts of c-type dogs are driven by arousal and energy expenditures that have little apparent relevance for the maintenance of homeostasis and security (comfort and safety). In addition, they are unable to engage in fair exchange or to show affect-attunement behaviors. Although they are intensely aroused by the pursuit of novelty and stimulus change, the hedonic significance of their actions does not rise to the level of awareness, and consequently they fail to encode awareness-dependent expectancies and engrams. Affected dogs treat everyone they encounter with the same energetic and exploitive enthusiasm, making few distinctions with respect to the way they engage insiders and outsiders.

A balance of opportunity with limit is crucial for managing information entropies in the direction of adaptive optimization. Goal-directed actions may successfully open the zona securitas but become increasingly rigid with order if not opened to sufficient opportunity. This pattern of progressive deterioration of adaptability is countered by means of utilizing the "noise" (prediction error) associated with the opening of the zona optimus consisting of modal adjustments to positive prediction error (cortical reward). Adaptive coping skills and the confidence to use them under varying circumstances are integrated by means of positive and negative prediction error in association with emergent power and freedom incentives. The strategy promotes competent skills (power) and freedom incentives sufficient to open and share social spaces consistent with the integration of secure attachments and adaptive optimization.

Autonomic attunement nodes activated around points of conflict alter thresholds controlling approach and withdrawal behavior and thus play a significant role in adjusting arousal and social exchange toward the *central field* (i.e., the point of balance between extraversion and introversion) and the opening of the zona securitas (somatic reward promoting comfort and safety) and zona optimus (cortical reward promoting hedonic value and elation). The adaptive optimization that normally occurs as the result of social exchange regulated by reliable expectancies is largely disrupted by a reactive coping style. Instead of organizing competent exchanges conducive to mutual appreciation, fairness, and interactive harmony, the social styles of c-type and m-type dogs tend to become increasingly impulsive and reactive incompetent. Finally, whereas dogs integrating an adaptive coping style are relaxed and ready in anticipation of rewarding social exchange, impulsive/reactive dogs respond to impending social exchange with preparatory anxious or frustrative arousal in anticipation of interactive conflict, thus mediating a heighten readiness to flee, exploit, or confront in response to social stimuli.

According to cynopraxic theory, both m types and c types are extremes that result from a failure to acquire the necessary autoregulation and awareness needed to integrate an adaptive coping style. Most dogs are distributed along the extraversion-introversion continuum by virtue of attachment and attunement dynamics (relative social attraction and aversion), their history of socialization and

training efforts, their acquired capacities to cope with interactive conflict, and their ability to process somatic and cortical reward competently. Although some individual dogs may closely resemble the extreme m and c types, the vast majority of dogs, under the stabilizing influence of an adaptive coping style and exchanges conducive to mutual reward (e.g., comfort, safety, and surprise) and attunement, integrate a phenotypic balance of extraversion (E) and introversion (I), showing behavior roughly corresponding to Pavlov's *sanguine* (s) types (stable extravert) and *phlegmatic* (p) types (stable introvert). The stable introvert and extravert operate under the influence of activity success within the central field organized around a sanguine-phlegmatic axis. The major difference between s types and p types is their respective sensitivity to signals predicting reward and punishment. Whereas s-type dogs are more sensitive to positive prediction error (better-than-expected outcomes) and cortical reward mediating active modal strategies (testing, searching, and exploring), p-type dogs show a greater sensitivity for negative prediction error (worse-than-expected outcomes) and somatic reward (comfort and safety) mediating passive modal strategies (hesitating, waiting, and ritualizing) aimed at securing comfort and safety while minimizing loss and risk.

In contrast, under the destabilizing influence of misattunement and interactive conflict (e.g., loss, risk, and disappointment), extraverts and introverts integrate reactive coping styles to accumulate destabilizing axifugal and axipetal load, roughly corresponding to Pavlov's c type (unstable extravert) and m type (unstable introvert)—behavioral tendencies conferring an increased vulnerability to impulsive and reactive disturbances, respectively (see *Experimental Neurosis* in Volume 1, Chapter 9). A third temperament variation combines features of both m and c types, referred to as a *nervous* (n) type. An n-type dog shows low reactive thresholds, making it prone to panic and helplessness associated with chronic insolvable conflict. N-type disturbances are characterized by conflict intolerance, compulsivity, and panic occurring under the influence of a *dysfunctional bias* toward change that cause affected dogs to persistently attribute danger and uncontrollability to significant events, even though the events are benign and highly amenable to proactive control efforts. N-type disturbances combine m-type and c-type characteristics along with persistent mood changes combining high levels of toxic anxiety and frustration (dysthymia).

Dogs showing n-type disturbance appear to cope with change through the distortion of a dysfunctional bias of danger and powerlessness that causes them to believe that whatever they do will have little effect on what ultimately happens. In situations involving choices between highly motivated alternatives (flight-or-fight conflict), such dogs are prone to panic (low reactive thresholds) or fall into a state of helpless resignation. Genetic predisposition, prenatal and postnatal stress, abusive rearing practices, and highly emotional social interaction lacking predictability and controllability may contribute to the expression of n-type disturbances. Paradoxically, highly ordered environments and social exchange that encourage excessive dependency and insecure social and place attachments may also impair a dog's ability to cope adaptively with the uncertainty of social and environmental change, contributing to a perception of change as being intolerably risky, unpredictable, and uncontrollable (see *Defining Insolvable Conflict* in Volume 1, Chapter 9). As a result, socially sheltered dogs may prefer insular conditions (e.g., they may "like" crate confinement) and seem most satisfied with rigid and monotonous routines.

The anxious–state arousal of dogs showing n-type disturbances appears to be of a different qualitative order than the stimulus-oriented anticipatory anxiety and bias for signals of punishment shown by m-type dogs or the action readiness and bias for signals of reward shown by c-type dogs. The persistent and conflict-reactive anxiety and anger-reactive responses to frustration associated with n-type dysfunction promote catastrophic conflict, with the affected dog appearing to lose consciousness. The panic behavior characteristic of n-type dogs depends on the predisposing influence of reactive thresholds controlling

the escalating activation of fear and anger. Dogs expressing low flight (fear bias) and low fight (anger bias) thresholds are prone to reactive panic in response to social exchanges perceived as posing an uncontrollable danger. Such dogs may show highly inappropriate and incompetent behavior in response to benign social stressors or impediments to freedom. N-type dogs sometimes show an anomalous intolerance for tactile stimulation, reacting to gentle handling and petting with panic-driven paroxysmal attacks.

Reactive emotional adjustments to change (e.g., depression, anxiety, worry, and panic) are prone to develop under social and environmental conditions perceived by a dog as unsafe and inescapable. According to this hypothesis, the impulsive and exploitive tendencies of the c type, on the one hand, and the anxious withdraw tendencies of the m type, on the other, are the default coping strategies of dogs exposed to situations perceived as uncontrollable, unsafe, annoying, and/or inescapable. The terms *social ambivalence* and *entrapment* are used to refer to these general social and environmental influences promoting a reactive coping style. Finally, stable and unstable orientations to reward (extraversion) and punishment (introversion) may originate in organizational processes first appearing in association with the parent-offspring conflict.

Coping with Conflict

Household social interaction, in all its nuances and refinements, is the result of human and canine adaptations to the competition and possessiveness arising from interactive conflict. Conflict sets the stage for the emergence of both reactive and proactive adjustments, depending on the abilities of the owner and the dog to prevent or avoid conflict when opening and sharing a *social space* (see *Social Spaces, Frames, and Zones* in Chapter 8). Although a dog's control interests are mostly confined to the pursuit of attractive motivational stimuli under a freedom incentive, an owner's control incentives are more often informed by power incentives. The owner may experience a strong sense of failure and inadequacy when unable to limit the dog's undesirable behavior. The loss of control experienced by the owner may heighten aversive feelings of anger and resentment toward the dog while mediating a state of misattunement, marginalization, entrapment, and social ambivalence. Many owners are under the persuasion of bad advice that a dog's conflictive efforts are motivated by a dominance incentive, causing the owner to engage the dog in exchanges that perpetuate and worsen the problems, rather than restoring social attraction and trust.

By necessity, while in pursuit of motivational interests, the dog is forced to negotiate around the owner's interference and control efforts. The attunement and social skills acquired when integrating an adaptive coping style serve to reduce conflict, whereas a chronic history of coercion, exploitation, frustration, loss, risk, and discomfort is likely to attune the dog and its owner to anticipatory expectancies that virtually ensure conflictive exchanges whenever they interact. The anticipation and preparation for conflictive exchange can be turned around and harnessed to cynopraxic objectives by integrating social exchanges with the dog that disconfirms the conflict expectancy. Instead of evoking unfair and conflictive exchanges where reward for one depends on loss or risk for the other, cynopraxic training focuses on restructuring and attuning social exchange toward mutual reward, cooperation, and trust. Social exchanges that satisfy the owner's social control needs (power incentives) while simultaneously gratifying canine seeking needs (freedom incentives) provide a basic structure that enables people and dogs to engage in mutually rewarding social activity.

Social interaction perceived as uncontrollable, unsafe, or biologically unfavorable may promote social and cognitive (attentional) disengagement, lower reactive flight-or-fight thresholds, and cause the dog to become increasingly irritable, intolerant, and reactive to social interference via the activation of a loner-dispersal survival mode. Chronic exposure to an impoverished or threatening social or living space in association with the dispersive tensions generated by an involuntary sub-

ordination strategy (ISS) may gradually exhaust a dog's stress-regulating abilities and sharpen household tensions. The degradation of interactive relations as the result of unresolved conflict may gradually result in exchanges unable to support secure attachments. As a result, the dog may become increasingly reactive toward ambiguous and relatively benign social signals as the emotional regulation afforded by attunement is lost in association with encroaching estrangement and mistrust.

The establishment of organized household relations is rarely achieved without significant interactive conflict along the way. Depending on how interactive conflict is managed, a dog may either adopt a voluntary subordination strategy (VSS) or an ISS (see *Interactive Conflict, Stress, and Social Dominance* in Chapter 7). Psychologically, a dog is organized to predict and control (i.e., manage) social events to exploit them for advantage. Excesses and deficits associated with such management interests are tempered by a sense of fairness, playfulness, and a love of social companionship with people. Under the benign influences of social leadership and the nurturance of a friendly VSS, interactive conflict and reactive tensions are gradually superseded by social attraction, mutual appreciation, and interactive harmony. Social and autonomic attunement serve to align and coordinate the cognitive and emotional processing needed by a dog to pursue its private interests competently while preventing, limiting, or resolving interactive conflict, as needed to consolidate social relations. Dogs adopting a VSS tend to become increasingly relaxed and confident while organizing an adaptive coping style and integrating secure social and place attachments. The pursuit of private interest becomes a public or household concern when it gives rise to competition and possessiveness aimed at *getting* and *keeping* some valued resource at an expense or harm to others sharing the home.

To achieve a state of relative harmony and peaceful coexistence, a dog must be compliant to owner control efforts, but the owner must in turn be able to compromise and to share the living space with the dog (see *Unilateral, Bilateral, and Pluralistic Relations* in Chapter 8). Most puppies and dogs come into the home as default subordinates but lack knowledge of the specific rules for sharing in household activities and resources. Subsequent interactive conflict results when the puppy or dog attempts to engage in reward-seeking activity in ways that conflict with owner power incentives. A puppy is best introduced into the home by means of identifying points of conflict and converting them into points of mutual reward and interactive harmony. Interactive compliance training (ICT) plays a critical role in facilitating social adjustments conducive to a VSS by means of conflict-resolving interactions. ICT serves to consolidate and refine the owner's control interests while the dog learns how to control valued resources and activities without engaging in disruptive competition. These rules are taught in process of integrating flexible *ascendant* and *descendant* relations based on a principle of fairness and pluralism, whereby sharing the living space is at the owner's consent and ability to assert veto power and *default dominance*, if necessary.

In the process of cynopraxic training, the owner and the dog shift from a reactive orientation fueling interactive conflict to a proactive orientation or *adaptive coping style* by means of social exchanges that optimize fair exchange and mutual reward, enhance the dog's ability to pursue power and freedom incentives in the absence of reactive arousal and interference, and integrate secure social and place attachments. Cynopraxic training theory postulates the following working hypotheses and claims regarding the integration of an adaptive coping style:

1. The loss and risk resulting from interactive conflict are experienced as emotional distress (anxiety and frustration) that preemptively conditions social approach with a negative efficacy bias (low-power orientation) in anticipation of conflictive exchange.
2. Emotional distress provides an aversive incentive conducive to the integration of proactive adjustments organized to prevent or avoid conflict.
3. The integration of prediction-control expectancies and calibrated emotional establishing operations organized in accord with fair exchange and reward promotes mutual attunement, causing

social approach to become increasingly relaxed and expectant of friendly exchange under the preemptive influence of a positive efficacy bias (high-power orientation).
4. Attunement coordinates energy-state changes via calibrated establishing operations and control expectancies to promote mutual reward and fair exchanges incompatible with conflict.
5. Chronic interactive conflict results in mutual powerlessness, entrapment dynamics, social ambivalence, and the activation of autoprotective modes, whereas conflict resolution promotes mutual empowerment, freedom, and secure attachments promoting mutual comfort and safety, mutual appreciation, and playfulness.
6. Cynopraxic training converts the energy diverted into conflictive exchange and resulting in homeostatic distress (energy loss) and turns it toward energy-conserving exchanges organized to resolve or prevent conflict in process of producing energy gains and homeostatic balance.
7. Exchanges yielding transactions producing energy gains are hypothesized to encode attunement via the calibration of emotional establishing operations. The preattentive comparator processing of energy gains scaled to hedonic value gives rise to a heightened state of awareness of pleasure. As such, the hedonic value attributed to energy gains and losses is an interpretive function or algorithm converting energy gains derived from better-than-expected outcomes into experiences and memories having the significance of pleasure (positive hedonic value), whereas the energy losses representing worse-than-expected outcomes are encoded into experiences having the significance of displeasure (negative hedonic value).
8. The energy gains obtained as the result of preventing and avoiding interactive conflict provide the trainer and the dog with the enhanced awareness and capacity to encode the significance of social exchange as experiences and memories needed to foster the social skills, autonomic attunement, and confidence (power) to engage in mutually rewarding cooperative projects and ventures. The power derived from the energy gains stemming from the resolution of conflict is integrated into predictive relations that open social space under the expansive dynamics of a freedom incentive. In contrast, the power lost due to energy losses stemming from interactive conflict results in the contraction of predictive relations, the closure of social space, and the accumulation of axipetal and axifugal load collecting in the opposite directions of unstable introversion and extraversion.
9. The effective resolution of conflict depends on the initiative and leadership abilities of the trainer to organize and guide mutually rewarding exchanges based on a principle of fairness (the golden rule), compromise, and cooperation around situations previously generating conflict.
10. Learning to prevent and resolve conflict results in mutual empowerment and liberation, with the dog and the trainer integrating the skills and the confidence needed to obtain mutual reward in the context of fair exchange and cooperation, as exemplified in play.
11. The translation of conserved energy into positive mood, mutual attunement, and stable predictive relations serves to promote social attraction and to open a social space within which people and dogs integrate secure social and place attachments.
12. Power and freedom incentives are most fully expressed in the form of affectionate play.
13. An attentional nexus conducts exchanges between the trainer and dog around points of common interest in the process of activating the SES and mediating autonomic attunement. The autonomic attunement and social awareness resulting from the activation of the SES simultaneously serve to disengage disruptive autonomic arousal driving conflictive control incentive and vectors, thereby enabling the trainer to turn his or her attention on the dog (and vice versa) as an object of affectionate appreciation and play.

14. With the emergence of power and freedom incentives focused on the mutual integration of social skills and confidence to avoid conflict, a principle of fairness and social codes naturally emerges to facilitate social exchange and attunement dynamics incompatible with conflict.
15. The mutual reward mediated by fair exchange serves to promote attunement, heightened awareness, and the joy arising from mutual appreciation and interactive harmony, as exemplified in affectionate play.

Under the influence of social ambivalence and entrapment, dogs appear to cope by withdrawing from the insecure/nervous attachment object, on the one hand, and by increasing their dependency on locations having conditioned associations with security (comfort and safety), on the other. Building social tensions (e.g., anxiety, frustration, irritability, and intolerance), impulsivity, lowered reactive thresholds (e.g., fear, anger, and panic), a preemptive negativity bias causing dogs to anticipate conflict with the approach of the owner, and the breakdown of social communication set the stage for reactive and impulsive autoprotective behavior. In addition to the retraction of the SES, a key factor in this process of estrangement and marginalization appears to involve the diversion of attentional resources to conflict monitoring, and *tuning out* the ambivalent attachment object. According to cynopraxic training theory, attention and impulse control are intimately interconnected and interdependent upon each other.

The disengagement of attentional resources combines synergistically with social withdrawal to imperil dogs with autonomic dysregulation and vulnerability for impulsive and reactive adjustments. These hallmarks of a nervous attachment make it difficult for dogs to experience coherent feelings of social security and belongingness in the home. The pervasive cognitive and emotional perturbations of chronic interactive conflict substantially disrupt a dog's ability to selectively attend to and decode the transactional significance of social exchanges with family members and to cope proactively with the most ordinary and benign social stressors. The ensuing dispersive tensions and marginalization may mediate an untenable insider-outsider orientation between the dog and the family members. In essence, the dog appears to undergo a process of estrangement and dissociation that gradually causes it to experience family members as "super pals" (tuning in) or as strangers and threats (tuning out), making them fit targets for impulsive attacks. If left untreated, such dogs not dispersed by rehoming or relinquishment, much as a captive wolf, unable to freely disperse or integrate is badgered and finally killed, may face a predicament of intensified social ambivalence, entrapment, and punishment, until at last the intolerable situation is disposed of by means of veterinary proxy.

Restraint, Unavoidable Aversive Stimulation, and Stress

Most dogs express flexible antistress and antiaggression capability but not in equal measure, with some breeds, on average, showing a greater proclivity toward reactive behavior than others (Malhut, 1958). Also, there is tremendous variation among individuals within the same breed that affects fearful behavior. In addition to differences affecting reactive thresholds in response to innocuous novel stimuli, Malhut found that breed-related differences affected the sort of coping style exhibited by the dogs. Corson and O'Leary Corson (1976) have also reported significant individual variation in the way dogs cope with isolation, physical restraint, and unavoidable electrical stimulation. Certain dogs—notably those belonging to herding, spaniel, and terrier breeds—show an ensemble of reactive behavioral and physiological changes when exposed to psychological stressors. These reactive dogs, which the researchers refer to as *antidiuretic* or low-adaptation types, exhibit a persistent pattern of increased metabolic activity and autonomic activation—physiological changes that typically occur in association with the sympathetic arousal and muscular exertion used to fight off or escape from a serious threat or

challenge. In contrast to the reactive pattern exhibited by antidiuretic low-adaptation dogs, other dogs showed a more passive coping style in response to unavoidable aversive stimulation and restraint. Many of these high-adaptation or *diuretic* types showed a transient antidiuretic response that diminished after several sessions of conditioning, whereas other dogs (most notably beagles and other hounds) showed little sign of disturbance in response to the stressors.

The antidiuretic stress response is hypothesized to be the result of an emotional conflict consisting of a strong incentive to escape coupled with an inability to break free of the Pavlovian-restraint apparatus. The ensuing conflict, escalating anxiety, frustration, and defensive arousal may result in elevated body temperature and various compensatory thermoregulatory activities aimed at restoring thermal homeostasis, including hyperpnea (panting), elevated heart rate, increased respiration, profuse salivation, high levels of plasma AVP (antidiuretic hormone), and reduced urine production (Corson and O'Leary Corson, 1969):

> In spite of the inability of the antidiuretic dogs to engage in fighting or to escape, the physiologic reactions of these animals appear to be those associated with severe muscular effort. We postulated that these dogs pant in order to dissipate the extra heat production associated with anticipatory responses to muscular effort. The excessive salivation serves to provide the water required for evaporative cooling during the hyperpnea. The antidiuresis serves the purpose of conserving water by the kidneys so as to make the water available for the increased secretion of saliva. (155)

The researchers found that after an avoidance contingency was introduced that allowed the dogs to avoid the electrical stimulus, many of the reactive antidiuretic dogs showed a marked shift toward normalization of autonomic tone and balance, but some of the dogs failed to adapt despite the most thorough training efforts (Corson et al., 1973). Among these nonresponders, a subgroup of antidiuretic dogs persistently reacted to restraint in the Pavlovian stand, with some chewing through harnesses and cables in their frenzied efforts to escape. The emotional effects of restraint were especially pronounced when the experimenter left the room, which suggests that the experimenter's presence exercised a significant stabilizing effect. The reactive behavior in response to restraint described by Corson and colleagues as hyperkinetic is reminiscent of a dog described by Pavlov that showed a similar pattern of reactivity and profuse salivation when restrained. Pavlov attributed the persistent autonomic reactivity shown by the dog to a thwarted *freedom reflex* (Pavlov, 1928) (see *Liddell: The Cornell Experiments* in Chapter 9, Volume 1). The descriptions by Pavlov of the dogs behavior seem consistent with the classical signs of separation distress/panic, representing the earliest known description of such disorder in dogs:

> One of our many dogs, used during the past year for the study of acquired, or conditioned, salivary reflexes exhibited especial characteristics. This animal when first used by us for experimentation gave, when placed on the stand, in distinction from all other dogs, a spontaneous and constant secretion of saliva during an entire month. This, of course, rendered it unsuitable for our experiments. This secretion of saliva is as we know from previous observations, dependent upon a general excitation of the animal, and is usually accompanied by dyspnea. Such excitation of the dog is evidently analogous to the state of excitation in the man, where it is manifested, however, by sweating instead of salivation. A short period of such excitation is seen in many of our dogs during the first experiments with them, and especially among the untamed and wilder of them. On the contrary, though, the dog in question was very tame and quickly became friendly with us all. That made it even more strange that for a month the excitation in the experimental stand did not diminish to any degree.…The spontaneous salivary secretion continued, and gradually increased with each experimental séance. Also the animal constantly moved, struggling in every possible way in the stand, scratching the floor, and pulling and biting at the frame, etc. (283)

Months of intensive counterconditioning failed to calm the dog and hypersalivation increased over time. Only after 4 1/2 months of isolation in a separate cage did the dog finally stabilize and become amenable to han-

dling and experimentation. Interestingly, in a language reminiscent of Nietzsche's "instinct for freedom" and slave morality, Pavlov contrasts the "reflex to freedom" with a "reflex of slavish submission," thereby placing the etiology of such behavior into the context of social imperatives and dialectics consistent with the interactive dynamics believed to contribute to the expression of nervous and insecure place/social attachments. Freedom of movement is a precondition for a dog to act effectively in accord with control and power incentives. As such, the loss of freedom associated with excessive crate confinement results in a significant loss of reward, as it forcibly separates the dog from the means needed to produce reward via the control of attractive and aversive motivational incentives. As a result of the combination of social isolation and loss of freedom imposed by confinement, the dog may experience a persistent state of internal conflict combining heightened anxious arousal and frustration.

The potent effects of crate confinement on the inhibition of urine production may stem, in part, from the release of AVP triggered by restraint and isolation of crate confinement. Corson (1966) reported that dogs living in small cages were prone to develop various nervous behaviors, including antidiuresis, reduced appetitive drive (e.g., anorexia and adipsia), and avoidance of social novelty (e.g., running away from strangers). QOL enhancements, which included housing the dog in a room and providing it with daily walks, helped to eliminate these aberrant behaviors. Social abuse, isolation, and restraint stress may underlie some of the persistent learning deficits exhibited by dogs exposed to excessive isolation and crate confinement. For example, increased opioid activity resulting from aversive interaction and chronic restraint stress may impair memory and associative learning capacities (Westbrook et al., 1997; McNally and Westbrook, 2003; McNally et al., 2004). Also, chronic stress causes glucocorticoid-mediated disturbances in cortical and mesolimbic DA reward pathways, and degrades cholinergic hippocampal circuits that preferentially mediate spatial and contextual learning.

These various stress-related changes in combination with autonomic imbalance and a concomitant rise in CRF, AVP, and NE may help to explain the crate-dependent aggression exhibited by some dogs. When restrained, crate-conditioned triggers may mobilize autonomic state changes and phase shifts in the direction of autoprotective action modes. When removed from the crate, these dogs appear to shift rapidly out of the dysregulated state into a state of excited arousal facilitating exploitive and impulsive exchanges but do not show any evidence of hostility. A similar pattern of arousal and dysregulation is predictably exhibited by some dogs while on leash, causing them to show an escalating state of aggressive arousal toward other dogs until they are released, whereupon they may rapidly (but not always) shift into a state of autonomic regulation conducive to exploitive and intrusive play.

A linkage with social isolation in the development of aggression has been frequently observed in the laboratory. Lagerspetz and Lagerspetz (1971), for example, found that mice selected for aggressiveness and nonaggressiveness for 19 generations showed significant variability with respect to learning aggression and their ability to cope with isolation stress. In one experiment, male mice were taken from these two groups at weaning and housed for several months in small groups. At month 8, mice selected for aggressiveness were housed in separate cages and tested on a weekly basis for 2 months. When tested at 8 months (prior to the first week of isolation), well-socialized aggressive mice showed no aggression when put in a novel cage with a nonaggressive mouse. After only 1 week of isolation, however, these same mice showed a rapid increase in aggressive reactivity that remained at a high level during the 8-week testing period. Even mice selected for nonaggressiveness showed increased aggression after 2 weeks of isolation. The authors emphasize the importance of social punishment as the decisive factor limiting aggressive impulsivity. As the result of retaliation and defeat consequent to aggressive actions, socialized mice appear to learn how to regulate their agonistic impulses. In the absence of punitive social

feedback, the predisposition toward aggression is heightened, a finding also reported among Hereford bulls (see *Play, Social Engagement, and Fair Play* in Chapter 8).

Paradoxically, after months of crate confinement, the crate may become a potent source of autonomic regulation promoting relaxation and sleep. Many dogs show a strong preference for sleeping in the crate and, if denied access to this "safe haven," often show signs of heightened autonomic distress and an inability to relax until they are put in their "den." Such dogs frequently show unproductive exploratory pacing, persistent panting, increased gut motility, and other signs indicative of autonomic dysregulation—all while the owner is nearby. When given access to their crate, these dogs immediately regain their composure, perhaps as the result of place attachments and security that they associate with the location. The behavior of these dogs is consistent with the distress behavior exhibited by dependent and insecure dogs when left alone. These sorts of observations have convinced many advocates of long-term cage and crate confinement that dogs really like being crated day and night—a bizarre belief that is used with great effectiveness on the low-power owner in order to help assuage guilt and rationalize excessive confinement of the dog. That a dog should prefer a state of social and physical privation and loss of freedom to the security and enjoyment of close company with family members is more rightly interpreted as evidence of social pathology than a healthy preference. The bond and QOL deficiencies evident in such a "preference" for social isolation and loss is antithetical to the goals of cynopraxic training and therapy (see *Mechanical Suppression of Behavior*).

Attentional Nexus, Allocentrism, and Attunement

The opening of an attentional nexus implies an appreciation of the other's viewpoint, that is, an allocentric orientation. The integration of an allocentric perspective translates the human umwelt into messages sensible to the canine umwelt and vice versa. Attunement is consequent to affective inferences (anthropomorphism) and attributions concerning the nature of the dog's doings. In fact, anthropomorphism plays a prominent role in the process of constructing a viable interface of affectionate and flexible exchange between people and dogs. These anthropic attributions and valuations provide a profoundly rich and complex cultural backdrop from which to receive and transmit affective information. Attunement dynamics are integrated at an early age, beginning with the undifferentiated approach behavior of neonatal puppies in search of contact comfort, appetitive gratification, and thermoregulation from the mother. These early protobehaviors are gradually incorporated in complex rituals used by dogs to negotiate conflict and allelomimetic behaviors. Among puppies, social facilitation invigorates the coordinated pursuit of common interests, at least until the activity threatens to escalate into conflictive exchange, whereupon social inhibition is evoked (Scott and McCray, 1967). These early attunement dynamics serve to promote social enthusiasm while curbing motivational momentum that might lead to overt antagonism.

Attentional Nexus, Social Communication, and Control

Domestication has significantly improved the dog's capacity to cope with stress and social uncertainty via the evolution of antistress and antiaggression capacities, enhanced attention and impulse-control abilities, exchange-mediated autonomic attunement, and the integration of a sophisticated SES consolidating these various changes (see Porges, 2003). As a result, the dog's ability to explore and rapidly establish social relations under a positive expectancy of reward is generally ascendant to negative expectancies and the social aversion associated with dispersion and entrapment dynamics. Dogs appear to respond to the presence of a person as an intrinsically rewarding object, with social contact possessing both incentive significance and hedonic value. For many dogs, petting is not only calmative but is also restorative in nature (see

Affection and Friendship in Volume 1, Chapter 10). The mere presence of a person nearby activates antistress capacities that enhance a dog's ability to cope with pain and stress. In addition to generally enjoying human social contact, dogs have evolved a proactive sociability that enables them to smooth over social tensions with conciliatory exchanges before they escalate into conflict. In short, dogs are developmentally organized to attune and commune with people. Along with these various changes affecting canine sociability and emotional adaptability, dogs appear to have acquired complementary sensory and cognitive capabilities that enable them to socially engage and communicate with people and to follow human instruction (Warden and Warner, 1928; Szetei et al., 2003).

Some authors have emphasized that the dog's enhanced abilities to initiate communicative interaction with people is due to an enhanced capacity for social gazing (Miklosi et al., 2003), perhaps augmenting the dog's abilities to decipher the significance of human social signals (see Hare et al., 2002). McGreevy and colleagues (2004) report that brachiocephalic breeds tend to concentrate receptor ganglion cells around the central area, in contrast to dogs with elongated muzzles that tend to express a visual streak (see *Orienting, Preattentive Sensory Processing, and Visual Acuity* in Chapter 8). Consistent with the aforementioned social-gaze hypothesis, these authors speculate that a genetic trend toward a frontal placement of the eyes and shortening of the muzzle might have developed as the result of selection pressures favoring visual capacities that enabled dogs to focus on the human face.

Relevantly, Viranyi and colleagues (2004) have observed that canine begging behavior is preferentially directed toward an attentive person rather than a person looking away from the dog. The authors suggest that such preferences might reflect an appreciation of human attentional cues insofar as they help to improve the success of instrumental food-sharing projects. The authors also found that a dog's ability to perform a basic obedience exercise ("Down") in response to a recorded command varied depending on whether the owner was out of sight, faced the dog, turned away, or faced another person while giving the command. The best performance was obtained when the owner gave commands while facing the dog, followed by commands given as the owner turned his or her head away from both the dog and person. The dog showed an equal disruption of performance when the owner was out of sight as when facing a nearby person. The authors interpret these findings as evidence of special attention-dependent capabilities. However, since most dogs can be trained to lie down rapidly and consistently in each of the previously mentioned stimulus and contextual conditions, and given the limited controls used in the experiment, it would seem extremely difficult to sort out what is attributable to the effects of owner-training skills versus the effects of special cognitive abilities expressed by dogs as a group. Although some acquired skills appear to depend on the help of directional cues for a dog to perform well, others do not. Warden and Warner (1928) explored many of these problems in the case of the dog named Fellow, finding that tasks such as sitting and lying down on command were not appreciably affected by changes in attentional focus or directional cueing, whereas routines that required the dog to move toward places or to select objects were much more dependent on attentional and directional cueing (see *Nora, Roger, and Fellow: Extraordinary Dogs* in Volume 1, Chapter 4).

Several authors have hypothesized that dogs have acquired, as the result of domestication, unique capacities for interpreting and responding to human directional cues. The dog's ability to translate directional information derived from gross and subtle pointing and indicating movements is well developed (Hare and Tomasello, 1999), seeming to surpass the abilities of chimpanzees and wolves (Hare et al., 2002). Although dogs are undoubtedly responsive to human deictic (pointing) signals, nonverbal directive signals, and social gaze, capabilities that trainers have fostered for centuries, it is not clear that this capacity is the result of special cognitive adaptations. To take an extreme example, unstable pointer dogs would likely show significantly less responsiveness to directional gaze and pointing cues than would stable counterparts,

not because pointers lack such ability but because preemptive reactions toward humans prevent them from showing that they have it. The ability of such dogs to use directional signals in appropriate ways only becomes fully evident when training them to hunt, as demonstrated by McBryde and Murphree (1974). In addition to training, the participation of an eager and playful pointer appeared to prime and attune an unstable pointer with arousal and direction that helped to break the spell of cataplexy. Once in their umwelt, the unstable pointers rapidly learned to show and respond to pointing signals:

> The performances of both nervous and normal dogs were quite comparable on an overall basis. The nervous dogs scored about as well throughout and just as well as the normal subjects on their last two trials which were intended to evaluate each dog's final abilities after rehabilitation. On an individual basis some of the nervous dogs did better than the normal controls. (81)

Despite significant changes away from the laboratory, their confident and human-friendly behavior did not generalize back to the laboratory, where they rapidly reverted to the same unstable and nervous behavior shown before field training. Apparently, in the absence of natural stimuli promoting drive arousal conducive to hunting activity (prey-seeking action modes and modal strategies), these dogs get *stuck*. The disorder does not appear to be primarily caused by fear or an aversion to novelty, since nervous dogs rapidly lost most of their timidity and could tolerate close human contact and the blast of a shotgun while hunting. Instead, these dogs appear to be affected by an overspecialization of function genetically encoded around hunting. Perhaps more fundamental, though, is the presence of a genetic defect affecting parasympathetic braking and accelerator functions. The ability to attenuate and accelerate arousal competently while remaining in a parasympathetic mode of activation may be an important aspect of domestication and herald the emergence of the canine SES (Porges, 2003).

Thus, individual differences affecting the dog's arousability and sociability (approach and withdrawal thresholds), motivational interest (incentive and hedonic value) in the reward object, susceptibility to conflict and distress during testing (anxiety and frustration thresholds), age, and relative social dependency (see Topál et al., 1997) would likely generate significant variability into any cognitive test relying on social and motivational variables not equally distributed among experimental subjects. These various influences represent additive confounds that have long been recognized as obstacles to the scientific investigation of animal cognition and continue to plague it with ambiguity.

To take an experimental example of the sort of risks involved in cognitive theorizing, Triana and Pasnak (1981) tested 32 cats and 23 dogs in eight standardized object-permanence tasks using a soft toy as the objects. Although dogs and cats completed some of the tasks, they consistently failed (with the exception of one dog) to solve the invisible displacement tasks. In a second experiment, two additional naive dogs and three cats were tested, but this time the researchers used savory treats and chunks of hamburger as rewards. Under the influence of enhanced motivation, the two dogs and three cats completed all eight of the tasks in a "logical manner." Now, if one took the results of the first test as a true estimate of canine and feline cognitive abilities, the interpretation would be consistent with the results of the experiment but wrong with respect to the dog's actual object-permanence abilities. Further, the second experiment might be erroneously interpreted as evidence of extraordinary cognitive skills, but neither experiment actually says much about cognition per se and instead underscores the reality that cognition and motivation are not easily dissociable, especially when the one variable is manipulated to test the other. Consequently, object-permanence tests employing such things as rubber toys may not measure the extent of cognitive capabilities as much as they measure a dog's motivational interest in getting the object concealed and their willingness to invest the attentional resources and energy needed to encode a working memory of it.

Pointing at a container concealing a treat is not a neutral deictic signal but may also carry the added significance of a command; that is, the directional cue may signify a demand "Go

there"—not merely indicating where the food is (i.e., a "There it is" signal) but carrying the added implication of a dominance imperative. Further, standing behind and pointing directly over an object may not necessarily be interpreted by the dog as a "Here it is" signal or a "Go there" signal but rather may project a "This is mine" significance. Accordingly, standing over and pointing at an object while repeatedly glancing from it to a dog should cause many dogs to withdraw from the object. In fact, many dogs can be caused to avoid forbidden objects merely by alternating glances toward the dog and back again while intently staring and pointing at the object. The effect can be very strong and appears to accumulate over repeated trials and may be augmented with auditory orienting signals. With regard to such dogs, learning to approach and take objects that are pointed at from above may be contraprepared. Dogs rarely, if ever, relinquish food to other dogs by dropping it and then glancing at the other dog and staring at the object to indicate that the other dog should take it. Such social signals when they do occur more likely carry an opposite significance, that is, represent a dare or challenge. Typically, when dogs give up objects, they indicate this intent by moving away from them. They are not particularly well adapted to engage actively in showing behavior with conspecifics when it comes to highly valued objects. The "Go there" imperative should also be subject to the influence of individual differences. In all of these cases, extraverts (with low-approach/high-withdrawal thresholds) should outperform the introvert (with high-approach/low-withdrawal thresholds).

The finding by Hare and colleagues (2002) that puppies perform the object-choice task fairly well from the start and that the "skill" does not appear to be much affected by rearing or social exposure to people seems inconsistent with the findings of other authors (see Soproni et al., 2001). The lack of effect resulting from rearing and social experience is especially puzzling given the findings reported by Topál and colleagues (1997), who found a strong correlation between the number of glances toward the owner, social dependency, and reduced problem-solving efficiency. Of course, one way to explain Hare and colleagues' findings is the possibility that the learning needed to decipher the significance of directional cues is epigenetically articulated into puppy behavior at an early age. The notion that complex social skills might emerge in the context of early ontogeny should not come as any surprise, nor should its significance be downplayed.

The social-cognition hypothesis faces other more formidable problems when the results are judged in the light of prior experimental work performed in Konorski's laboratory. In a series of delayed-response experiments performed by Lawicka (1959), dogs were taught a 3-choice response that depended on the directional information provided by a 3-second orienting signal, a buzzer emanating from one of the different locations. After a variable duration delay, with or without intervening distractions (e.g., feeding the dog or taking the dog from the room), the dogs were released to choose. Dogs readily learned to make the correct location-choice responses, despite distractions, long delays, and even after falling asleep. In one dog, delays of over 18 minutes proved of little difficulty, with the dog making no errors in 7 trials (see Lawicka, 1959:202). Thus, the dogs did not depend on body orientation, but appeared rely on an oculocentric map to orient toward the signalled location.

Lawicka's findings suggests that the distance between the boxes from where the buzzer emanated appeared to enhance the integration of predictive information into the canine localizing map. When the boxes were widely spaced apart (e.g., over 12 feet) the dogs perform the location-choice task after long delays with few errors, whereas when the boxes are placed close together the delay abilities of the dog are "drastically reduced." These observations are extremely interesting since they appear to suggest that delayed response capabilities are partially dependent on the spatial distribution of reference points scaled to coordinate action to locate stationary objects concealed at some distance away, perhaps revealing significant features of the canine umwelt. One might expect that moving objects, including those in slow motion, would not yield lasting memory traces of a

location but might yield predictions concerning the future location of the object based on a trajectory, speed, and prominent terrain markers. Accordingly, allowing the dog to briefly (2 seconds) observe another dog walk by in front of the house before closing the door and taking it to another room for a brief delay, reveals that the dog immediately angles off in the direction last observed, even though, in fact, the dog was immediately turned about and walked in a opposite direction after the door was shut.

Lawicka and Konorski (1959) observed that prefrontal dogs treated directional cues much like a pointer orients and freezes its focus and posture in the direction of the cued location, thereby depending on proprioceptive and vestibular signals to hold on point. discounted the value of such responses with respect to cognitive function, however, referring to them as "pseudo-delayed," since the arrangement could not exclude the confounding possibility that the dog was relying on propioceptive and vestibular propioceptive and vestibular signals when orienting and making location-choice responses. In addition, Konorski and Lawicka (1964) found that dogs suffering prefrontal lesions are still able to correctly follow directional signals, so long as the signals were closely tied to the object's location and that the dog was released during or shortly after the directional cue was discontinued. Now, if dogs with massive prefrontal lesions can "solve" such problems by remaining physically oriented on the location during the delay period, it makes it difficult to assume that the performance is strictly speaking of a cognitive nature. These findings are bad news for the social-cognition hypothesis. If a dog without a functional prefrontal cortex can perform the requisite orienting and approach response, then the social-cognitive hypothesis is falsified, that is, the action might not depend on cognitive ability at all.

In order to overcome these confounding influences, delayed-response procedures can be designed with built-in interference effects that filter out positional information, e.g., the dog is turned around, distracted with food or petting, and even momentarily taken away from the starting point before being released again to choose. Interesting work performed by Nippack and colleagues (2003) appears to have avoid many of these obvious experimental pitfalls while exploring the effect of delay on latency and response accuracy.

Sensitivity to Human Attentional States

One might expect that under circumstances in which deictic signals result in interference or exploitation by an observer that a dog might employ gaze amd directional cues to turn the other's attention away from the location or object of interest. The results of a study by Call and colleagues (2003) might be interpreted as evidence of tactical behavior organized to evade interference by adjusting risky ventures to changes in human orientation, proximity, and attention. In their study, dogs were exposed to training in which a piece of food was placed on the floor, whereupon the experimenter looked at the dog and said "Aus!" (Out!), followed by a second event in which the dog's name was called and followed by "Aus!" again. The dogs were subsequently exposed to a series of test trials that continued until the dog either took the food or 3 minutes had elapsed. If the dog took the food without permission, it was not punished, nor was it rewarded if it refrained from taking the food. As such, the procedure appears to asymmetrically favor approach over avoidance, since dogs that took the forbidden food were merely ignored, just as those that obeyed the prohibition were ignored. With only one exception, all of the dogs took the food at least once, and some of them took food on several occasions while they were watched. However, watched dogs generally avoided the forbidden food but readily took the food if released to do so or when left alone with it. In a follow-up experiment, the dogs appeared to be aware of the attentional state of the experimenter based on the orientation of the experimenter's direction of gaze. When the experimenter faced the dog with closed eyes, the dog tended to respond to the frontal orientation as it did when the experimenter's back was turned to the dog. These findings suggest the possibility that dogs might know when they are being carefully observed. When closely watched, the dogs broke the prohibi-

tion against taking the food much less frequently, engaged in more indirect approaches to the forbidden item, and appeared less relaxed (i.e., sat more often and laid down less often) during the test trial. The indirect approach might have enabled the dogs to keep an eye on the experimenter while nearing the object or taking a more advantageous position from where to approach the food item.

A remarkable aspect of the experiment by Call and colleagues is the degree of appetitive suppression achieved by virtue of two vocal warnings, essentially events that emphatically served to draw the dogs attention to the food in association with a social startle/threat implication. One possible explanation for the extraordinary control exerted by vocal reprimands may stem from the unfamiliarity of the testing situation and the person delivering the threat. Another possible factor might be traced to prior inhibitory training. Some of the dogs may have received aversive inhibitory training that conditioned them to refuse food not given to them by the owner (e.g., poison proofing). Poison-proofed dogs usually show a strong avoidance and rejection of illicit food that they might find or have offered to them by strangers. In contrast, the dogs in the test group eventually took food when released or when left alone, strongly suggesting that they were not behaving under the influence of situational anxiety or aversive inhibition. Apparently, the experimenter remained neutral whether a dog ate the food or not. From a behavioral aspect, the effect of such a procedure would be far from neutral. In fact, such a strategy should have resulted in a significant differentiating effect with respect to dogs that ate and those that were inhibited. Dogs that ate the food in the presence of the neutral experimenter should have been doubly gratified by the disconfirmation of the avoidance contingency and by the successful control established over the food item without cost or interference. Learning theory predicts that such rewarding outcomes should reduce inhibition and conflict in dogs about taking food in comparison to dogs that continued to avoid the food.

Appetitive Suppression, Social Attraction, and the Attribution of Intention

Matters are further complicated by the fact that dogs tend to cope with social inhibitory conditioning in ways that are highly variable and strongly influenced by constitutional differences and prior rearing practices (Freedman, 1958). Freedman studied the ontogeny of these effects in several breeds. Puppies selected from these breeds were divided into two groups: one group had been reared with disciplinary handling and the other reared with social indulgence. At week 8, disciplined and indulged puppies received several days of inhibitory training during which they received swats on their rumps together with loud vocal reprimands whenever they ate meat from a bowl that was located in the middle of a room. The aversive contingency exerted a differentiating effect on social and appetitive approach behavior that was correlated strongly with the rearing breed of the puppy and only partially with rearing history.

After the experimenter left the room, basenjis, which showed a strong environmental and novelty orientation, tended to eat from the bowl straightaway, whether they had been punished or indulged, whereas shelties, which showed a strong social avoidance, consistently avoided the food during the full 8 days of testing, regardless of their rearing history. In contrast to the social aloofness of the basenjis and the social avoidance of the shelties, the beagles and wirehaired fox terriers showed a high level of attraction and interest in the experimenter. Depending on their previous rearing history, these breeds also differentiated into separate groups after punishment training. Indulged puppies showed a greater amount of avoidance toward the meat than did puppies that received disciplinary treatment prior to punishment. Of particular interest with respect to the long-term effects of such treatment, indulged beagle puppies receiving punishment training at week 8 showed evidence of delayed changes in social behavior consistent with a loss of trust and safety stemming from the earlier punitive experience. During follow-up tests from weeks 11 to 15, these indulged-punished beagle puppies became wary when approached by

handlers and increasingly difficult to catch—behavior that sharply contrasted with their earlier sociable attitude and behavior. The so-called second fear period may actually be related to the retraction of residual social attraction or its loss as the result of interactive conflict, releasing conditioned social fear acquired earlier in life.

Freedman's findings indicate that early rearing practices and individual differences can strongly influence how dogs respond to appetitive inhibitory training. The individual differences associated with appetitive inhibitions would seem to represent a significant confounding influence for cognitive studies such as the one performed by Call and colleagues. According to Freedman's work, some dogs should simply avoid food in the presence of the experimenter, whereas others should simply ignore the warning and take the food at the first opportunity. Dogs most likely to differentiate behavior in response to reprimands would need to have a high level of social attraction.

Another problematic influence is prior safe or unsafe exposure to food. Under normal household conditions, dogs frequently find bits of food fallen to the floor, which they are usually permitted to eat without consequence. Most dogs are also accustomed to obtaining food as rewards from their owners or to obtaining it by searching countertops and trash bins—efforts that are intermittently successful and may persist despite the use of contingent and belated punitive efforts. Dogs regularly receive small portions of food as rewards consequent to the performance of obedience tasks. Food is also sometimes used to relax anxious dogs via its calming effects on aversive emotion and arousal. The idea here is that preexposure to food would likely build a significant level of prior conditioning and bias that should impede or facilitate the acquisition of inhibitory conditioning (see *Stimulus Factors Affecting Conditioned-stimulus Acquisition and Maintenance* in Volume 1, Chapter 6). Further, there might be an intrinsic contrapreparedness associated with learning to avoid appetitive objects via aversive threats. Rats, for example, exposed to brief foot shock and other aversives (e.g., ammonia, mustard, or quinine) as they approached a highly preferred food item (an Oreo cookie), or as they ate the cookie, continued to show a persistent appetite for the object. In contrast, rats exposed to nausea-producing lithium chloride acquired a rapid and cross-contextual aversion toward the cookie, perhaps indicating a certain degree of independence between cutaneous and alimentary defense systems. When subsequently tested, the shocked rats showed only momentary hesitation before eating the cookie in the training cage where the shock took place but showed no hesitation before eating the cookie while in the home cage or when tested in a novel cage (see *Prepared Connections: Taste Aversion* in Volume 1, Chapter 5).

Despite biological contrapreparedness, lasting food inhibitions can be established rapidly with severe physical or electrical punishment but not without risking neurotogenic elaborations. Lichtenstein (1950) demonstrated that appetitive behavior could be fully suppressed by the delivery of one to three electrical shocks (2 seconds of 85-volt AC each), if the aversive events were timed to overlap the act of eating, whereas significantly more repetitions of shock stimulation (23 to 29 shocks) were required if it was delivered immediately before the presentation of food (see *Lichtenstein's Experiments* in Volume 1, Chapter 9), again raising additional questions about the size, durability, and ease with which Call and colleagues were able to establish a stable inhibition of appetitive behavior.

Chairs and Minds: On Knowing What a Dog Knows About Attentional States

A more serious set of problems for Call's attentional state hypothesis is posed by the findings reported by Solomon and colleagues (1968). The experimenters were interested in the delay of punishment effects on the highly motivated appetitive behavior of starving dogs. During the training phase of the experiment, the dogs were deprived of normal rations and caused to lose more than 20% of their normal body weight. They were presented with two food bowls, one containing 20 grams (approximately a tablespoon and a

half) of dry food and the other containing 200 grams (less than a cup) of horse meat. The food bowls were arranged so that they were within the reach of the experimenter, who sat in a nearby chair armed with a tightly rolled-up newspaper in hand. If the dogs limited their interest to the dry food, which they were permitted to eat, they were ignored without consequence; if the dogs ate the meat, however, they were hit sharply across the nose with the newspaper. Some of the dogs were swatted just before they touched the forbidden food, whereas others were punished after a 5- or 15-second (s) delay, during which they were allowed to eat. Dogs showed a spectrum of intense fearful behaviors and sustained food aversion differentiated in various ways depending on the timing of punishment. Approach toward the forbidden food item was suppressed rapidly in all three groups of dogs, requiring as few as three or four hard swats.

After the training phase, the dogs were given several daily 1-hour feedings to allow them to regain the weight they had lost. At the end of this period, the dogs were deprived of all food for 2 days. During the testing phase, all food was obtained during "temptation tests," which consisted of dry kibble and a bowl of horse meat. The experimenters found that dogs were so intimidated by the treatment that they would starve themselves, on average, for 16.3 days (no delay), 9.7 days (5-s delay), and 1.5 days (15-s delay) rather than eat the preferred meat, even though the experimenter was out of the room and the punishment contingency had been discontinued.

An interesting aspect of this disturbing study is the finding that the dogs showed opposite patterns of social behavior, depending on whether punishment was immediate or delayed. The no-delay group, upon entering the experimental room, skulked around with the head and tail down and staying as far away from the experimenter and the forbidden food as possible. In contrast, the delay groups entered the experimental room with an appearance of immense excitement, tail wagging, and jumping up on the experimenter. As they approached the food and took a few bites, their behavior dramatically changed: with their tail drooping down, they would slink behind the experimenter's chair or circle the room, go to a wall, and then crawl on their belly to the experimenter, whereupon they would wag their tail, furtively take some more food, and retreat again. During the test phase, when the dogs were left alone they behaved as though the experimenter was still present. Even though they were free to eat the meat, they could not initially do so. In the case of no-delay dogs, the taboo broke down very slowly, but when they finally began to eat the meat they did so in an uninhibited fashion, wagging their tail and not showing any sign of anxiety. In contrast, when the delay dogs finished eating the dry food, they would often put their paws on the experimenter's chair or go behind it from where they would wag their tail when they looked in the direction of the empty chair. The dogs appeared to treat the chair in ways that mirrored the behavior they showed when the experimenter was in the room. For these dogs, the taboo against eating the meat broke down much more rapidly, but they never lost their apprehensiveness while eating and remained anxious after eating.

The findings reported by Solomon and colleagues are at significant odds with the attentional state hypothesis. The 18 dogs in this experiment appeared unable to differentiate the relative degree of threat posed by the presence or absence of the experimenter. In fact, in the case of those dogs punished after a brief delay, they continued to treat the experimenter with animated excitement at the beginning of each session, only showing evidence of fear after they had taken some food. The trigger stimulus of anxious arousal relative to the experimenter was elicited by the act of taking food, not by the presence of the experimenter. During the test phase, the delay dogs were observed to approach the chair and behave as though the experimenter was still present. Of course, a chair does not possess an attentional state, but the dogs nevertheless showed behavior toward the chair and surroundings as though it did. The authors interpreted this social behavior in vacuum as an expression of *conscience*.

Whether the previously described experiment performed by Solomon and colleagues would qualify as such falsification is not clear, but it does raise a number of questions about how dogs perceive and use human attentional states. The questions raised here need to be answered by means of clever experimental designs that can unambiguously rule out lower levels of organization (e.g., stimulus and context learning). The accumulated data of 100 studies performed to prove some inductive belief or generality are vulnerable to upset based on a single well-designed experiment demonstrating an irrefutable counterexample. The use of vocal threats or physical punishment to test cognitive capacities seems particularly onerous, clumsy, and inappropriate to the task, especially insofar they are likely to impact a dog on numerous levels, making it difficult to disambiguate a canine orientation to attentional states and a complex chain of conditioned responses associated with the object and surroundings.

A problematic aspect of Solomon and colleagues' method deserves mention, to wit: how was the experimenter able to swat dogs belonging to the 15-s-delay group while they were still eating. Considering that these dogs were starved, one would expect that several of them (at least) should have been able to bolt down 200 grams of meat in less than 15 s and thereby beat the punishment contingency. Frankly, the notion that a starving dog would take 15 s to eat less than a cup of meat seems inconceivable.

Complex Social Behavior and Model/Rival Learning

Dogs appear to be highly sensitive to social modeling and training effects that occur in the context of exchanges between two human demonstrators—a trainer and a model/rival—interacting with an attractive object in the dog's presence. The method of model/rival (M/R) training has been most thoroughly investigated in the context of training parrots (see Todt, 1975; Pepperberg et al., 1999; Pepperberg, 2002). Todt's work with parrots is organized around the incentive value of attention directed toward a familiar and previously cooperative person who has ceased to be so and made to become a *rival* for the attention of a second person who remains a cooperative *partner* to the bird. In this paradigm of instruction, the rival's vocal expressions prompt close attention and interest by the partner (trainer), thereby modeling vocal behavior relevant to attracting attention and interest from the cooperative partner. Whether the incentive governing the acquisition of vocal behavior is related to reward associated with social attention or merely the result of focusing the bird's attention on the rival's behavior is unclear, but Todt notes that, while the birds learned words from the rival, they tended to use words to communicate with partner/trainer.

A study by McKinley and Young (2003) purports to compare the relative efficacy of a modified M/R method with shaping for training a vocally discriminated selection-and-retrieval task. The authors suggest that both methods perform about equally well. However, since the design is not adequately controlled for making comparative assessments (e.g., all of the dogs had been previously trained to retrieve), it is difficult to say what the study results actually measure. From the brevity of the training used to reach criteria levels and the weight of other evidence provided, the comparable performance of the dogs tested was probably the result of transient motivational changes, classical conditioning, and prior training to retrieve, rather than reflecting effects specifically due to instrumental or M/R training. Another possibility is that the results reflect a prepared ability to rapidly associate word meanings with the act of retrieving objects via a process akin to *fast mapping* (Kaminski et al., 2004). At a minimum, such experiments require that baseline data be obtained to assess prior learning and skills that might confound the behavioral change that one wishes to use as a comparison to measure the relative effects of the independent variables. Since such baseline data were not collected, it is impossible to determine from their data whether any significant effect on retrieve behavior occurred as the result of either of the training procedures. Further, the experimenters moved immedi-

ately from the training procedure to the test trial, suggesting that the comparable effects of the two methods may have been due to arousal and motivational changes (establishing operations) activated by the target object that in turn served to recruit previously learned retrieval responses.

Preliminary Experiments and Observations

Preliminary results of a series of experiments performed to explore possible effects of a modified M/R method indicate that dogs may be more sensitive and responsive to social learning via observation than previously suspected. These experiments appear to reveal a form of rapid complex social learning in dogs that was not previously described in the scientific literature. The experiments indicate that dogs may rapidly acquire and integrate the attunement dynamics of two persons making exchanges involving an object valued by the dogs.

The procedure consists of an observing dog, a partner/trainer (P/T), a model/rival (M/R), and an object of significant interest (OSI) to the dog. The M/R plays a combined role of stimulating rivalry for the trainer's attention while attuning and modeling behavior in response to the P/T's signals, prompts, and rewards. The experiments were performed in a home environment and involved two familiar demonstrators, who sat on the floor facing each other approximately 3 feet apart. The dog, a 2-year-old, male, Belgian Malinois, was signaled by the P/T to lie down and to stay at approximately 6 feet away from the P/T and the M/R. The dog showed a strong interest in both objects used in experiments 1 and 2.

Experiment 1

The first experiment (1A) involved the dog observing the demonstrators interacting with a favorite toy (a ball). In the first interaction, a brief fuss was made over the ball while the demonstrators tugged back and forth on it. The P/T finally pulled the ball forcefully away from the M/R, and then, after a brief pause, the ball was put on the floor approximately 2 feet away from an identical ball. The dog was released and observed. A second experiment (1B), employing an identical arrangement, was performed immediately after experiment 1A. This time, though, the demonstrators interacted more quietly and cooperatively, with the P/T now giving the M/R the ball with "Take it," saying "Good," and then asking the M/R to give the ball back with "Out." As the M/R handed the ball back, the P/T said "Good" and immediately thereafter gave the object back again in a friendly way, saying "Take it" and "Good" as the M/R took the ball again. This pattern was repeated two or three times before the ball was placed on the floor in the manner previously described.

The results of these experiments were extremely surprising. Observing human interaction with the ball beforehand exerted a pronounced affect on the dog's subsequent response to the object. In the case of experiment 1A, the dog went directly to the ball, rapidly picked it up, became unusually possessive over it, and made vigorous efforts to evade being caught when the P/T tried to take the ball. This behavior was in striking contrast to the dog's ordinary willingness to give and release toys. Equally striking and remarkable was the dog's change and demeanor following experiment 1B. After observing the demonstrators interact in a more friendly and cooperative way with the item, the dog went to the ball, picked it up in a much more relaxed manner, went to the P/T, and allowed him to take it away. Extraordinarily, these dramatic changes in complex social behavior were produced within the context of a 10-minute period.

Experiment 2

Several days later, the same dog was observed under a similar basic arrangement, but this time another toy (e.g., a stuffed animal) was used and the P/T and M/R staged another set of exchanges for the dog to observe. In the first of these experiments (2A), the P/T showed the object to the M/R, sharply said "Leave it," and made a slapping action toward

the M/R's hand. This procedure was repeated two or three times. After a brief delay, the toy was put on the floor and the dog released. In the second experiment (2B), the P/T presented the toy to the P/T, saying "Take it," and then "Good" as the M/R took the object. After a moment, the P/T, saying "Give," asked nicely for the object, whereupon the M/R handed the toy back and P/T said "Good." This friendly exchange was repeated two or three times, before the object is placed on the floor and the dog released.

Again, quite unexpectedly and surprisingly, the dog's behavior toward the toy changed rapidly in directions consistent with the way in which the P/T and M/R interacted with the object beforehand. In the case of experiment 2A, the dog, normally highly object driven and enthusiastic, only slowly and tentatively approached the object, then hesitated, and turned away without picking it up. Instead of taking the object, the dog went to the M/R, as though to check on her, while appearing to ignore and avoid the P/T. By contrast, after observing the cooperative interaction between the P/T and the M/R staged in experiment 2B, the dog went directly to the toy, picked it up, and took it to the P/T.

Social Cognition, Scripts, and Modal Styles

The clarity, contextual appropriateness, and rapidity of the complex behavioral adjustments shown by the dog in response to observing social exchanges between the P/T and M/R were truly extraordinary, going well beyond what one might expect from the low estimations normally attributed to observational learning in dogs (see *Social Learning* in Volume 1, Chapter 7). The dog seemed to grasp accurately the social significance of the interaction between the P/T and the M/R and to adjust its behavior immediately toward the object and the demonstrators accordingly, as though he had directly experienced the stimulation firsthand. These remarkable changes in behavior, occurring in response to staged demonstrations, suggest that the model/rival procedure may offer a powerful tool for studying developmental processes, affect-attunement dynamics, and canine proxemics (see *Model/Rival Theory, Fair Play, and Sibling Hierarchy* in Chapter 8), as well as suggest a variety of behavior therapy and training applications. For example, in addition to an apparent value for developing object preferences and avoidance, dogs exhibiting possessive or overt guarding behavior might be helped to interact in a more friendly and cooperative manner by observing a trainer and model/rival exchanging positive vocal signals and gestures signifying safety and comfort around trigger objects. In addition, it may have value in the context of reducing impulse-control deficiencies by demonstrating to the dog more calm and cooperative exchanges organized around desirable objects. The apparent attunement and social scripting fostered by M/R method may help to explain certain social excesses associated with hyperactivity. For example, in situations where children routinely roughhouse around objects of interest to a dog, M/R learning effects may strongly affect the dog's behavior toward the children and the objects.

The robust and remarkable effects produced by the M/R method is deserving of experimental scrutiny. The apparent sensitivity that dogs exhibit for attunement information derived from social demonstration suggests that such learning may play a significant role in behavioral organization. The arrangement does not exclude the possibility that the dog might be responding to conditioned or unconditioned stimuli that generate preparatory arousal and subsequent expressive behavior similar to the rival's modeled behavior. Of course, such preparatory influences would not necessarily be incompatible with the possibility that such interaction might also exert cognitive organizing effects. Further, even if the effects are restricted to the transmission of attunement effects, such capacities for behavior-therapy purposes are not insignificant. The dramatic and rather precise nature of the behavioral output associated with M/R demonstrations is consistent with the possibility that M/R learning might involve processes that conduce attunement and encode modal scripts or styles of exchange with the object mirroring the model/rival's behavior. This

hypothesis is consistent with the tendency of some young dogs to adopt various modal styles and nuances of behavior shown by other dogs perceived as possessing effective leadership qualities (perceived high power). Model/rival learning appears to enable observing dogs to mirror the affect and actions observed between the M/R and the P/T. Structuring behavior in accord with attunement scripts observed taking place between the M/R and P/T would allow dogs to integrate rapidly into social activities. Such abilities might be particularly active in the modal behavior and styles of playful newcomers and young animals seeking acceptance into an established social group. The capacity to exhibit behavior that "feels" like the style of others may cause group members to perceive the newcomer as being familiar and to more readily accept and integrate the *poser* into the group.

Attention, Model/Rival Learning, and Mirror Neurons

The ability of dogs to *style* behavior in conformity with the attunement dynamics observed between demonstrators would suggest the involvement of a complex computational apparatus for extracting socially significant information and making accurate affective inferences about its significance. One line of neurobiological research in monkeys has shown that the ventral premotor cortex encodes a mirror representation of the actions made by others of a form similar to the representation made when the animal makes the action itself (Umilta et al., 2001; Ferrari et al., 2003). In addition to actions seen, these mirror neurons represent what is heard in association with actions but remain inactive to other sounds (Kohler et al., 2002). Mirror neurons appear to provide the animal the ability to discriminate action based on auditory, visual, and motor information (Keysers et al., 2003). These findings suggest the possibility that these mirror neurons may be part of a larger network comprising a neural matching/comparator system that would enable social animals to rehearse the form or script of social behavior observed in the behavior of others before acting on it. Thus, the encoding of a mirror representation at the stage of premotor processing may be "transformed into potential actions in the mirror system such that the perception-action link related to action representation is activated already during observation" (Nishitani and Hari, 2000:918). The ability of parrots to acquire and express complex vocal sounds based on hearing in the context of model/rival enactments may be facilitated by a similar process of mirror representation whereby complex vocal sounds are encoded by auditory mirror neurons and subsequently decoded by motor programs controlling vocal behavior.

The observed action represented as potential action by mirror neurons may be attributed with affective significance by cortical and limbic processing before being expressed as an action attuned to the social circumstance. Unlike parrots with their imitative behavior, dogs may be more inclined to recast the potential action represented by mirror neurons by turning attention toward the quality of feeling informing the observed exchange. According to this hypothesis, dogs are more interested in the affective significance of the M/R demonstrations than in imitating the specific form. These sorts of prepared social learning capacities may be particularly important to domestic dogs, whose social acceptance depends on their ability to attune and commune with family members. The genetically augmented play capacities of dogs may include an automatic representational framework for decoding and attributing affective significance to potential actions, enabling dogs to transition from the external form of playful exchanges to a subjective experience of shared internal feelings (joy) arising in the process of mediating attunement and secure attachments.

PART 3: ETHICS AND PHILOSOPHY

Cynopraxis and Ethics

A Delta Society publication aspiring to set professional standards for dog trainers lists three primary ethical criteria that the authors believe qualify a procedure as humane:

"Humane dog trainers use and advocate methods that rely on: eliciting and reinforcing desired behaviors, inhibiting and discouraging unwanted or potentially dangerous behaviors, minimizing the use of aversives while doing either of the above" (Delta Society, 2001:2). Defining ethical behavior exclusively in terms of technical means irrespective of aims is inherently circular and limited with respect to ethical practices.

Ends

Without defining the aims of training, such rather tinny behavioristic criteria as set by the Delta Society are virtually meaningless with respect to humane-practice criteria. Numerous questionable training activities might be construed as ethical and humane practices merely because they are performed in adherence to these sorts of standards. The second criterion violates the dead-dog rule and the third criterion neglects to consider the adverse impact of overly intrusive methods (see *Hydran-Protean Side Effects, the Dead-dog Rule, and the LIMA Principle*). According to these recommendations, putting a dog in a crate and training by means of a tedious autoshaping program would be considered ethical and humane, even though a human is never involved in the training process. Evaluating the ethical and humane use of means in the absence of appropriate consideration of the ends to which they are applied is logically flawed and produces many absurd implications. For example, dogs trained by the Russians during World War II were desensitized and conditioned with food rewards until they either ran between the treads of an approaching tank or ran alongside it, whereupon an ordinance strapped to their bodies was detonated. Since antitank dogs were trained by "eliciting and reinforcing desired behaviors," applying the aforementioned criteria suggest that training of antitank dogs was ethical and humane.

The criteria listed for identifying behaviors to be reinforced or "inhibited" are strictly limited to anthropic interests; that is, those canine activities that the trainer finds desirable or undesirable without reference to the dog's needs and QOL. Canine adjustment problems cannot be effectively treated without normalizing the social and environmental circumstances producing the objectionable behavior. Merely reinforcing or punishing what one likes and dislikes is not likely to prove very beneficial in the long run.

These concerns emphasize the profound influence that training objectives have on matters pertaining to ethical standards. A ruthless person may use kindness and gifts in order to deceive and gain the confidence of others, with the goal of eventually harming or taking advantage of them in some way. Such manipulation is obviously unethical and can hardly be considered humane. In a poignant way, Bertrand Russell (1997) has stressed the potential risks associated with the formation of faulty expectations based on an assumed uniformity between means and ends:

> Domestic animals expect food when they see the person who feeds them. We know that all these rather crude expectations of uniformity are liable to be misleading. The man who has fed the chicken every day throughout its life at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken. (63)

Russell's chicken, like the Russian antitank dogs, was duped by a faulty extrapolation from means to ends.

Under natural conditions, animals change their behavior in order to improve their ability to control environmental resources and events that contribute to their survival and well-being. Accordingly, instrumental behavior is strengthened when it succeeds in enhancing an animal's ability to predict and control the occurrence of some significant event and weakened when it fails. Dog training is based on a contrivance that exploits canine learning to shape and control an artificial repertoire of behaviors patterned toward some training objective that may or may not be in a dog's best interest. In the context of training, reward and punishment are arbitrarily arranged to occur in accord with the trainer's plans to render the dog's behavior more predictable and controllable. The dog's ability to predict and control these events is preempted by rules established by the trainer in advance; that is, the game is rigged to allow

only those changes in the dog's behavior that suit the trainer's purposes.

Just as a dog's behavior is shaped by its ability to control attractive and aversive events arranged by a trainer, the trainer's behavior is subject to modification by the relative success or failure of training exchanges to meet objectives. Efforts that successfully increase control over a dog's behavior are strengthened, whereas efforts that fail to increase control are weakened. As such, practical dog training is inherently reward based insofar as contingencies are arranged to enable dogs to gain control over motivational events by means of signaled actions consistent with the training objective. Only an irrational trainer would set up contingencies that were deliberately arranged to make a dog fail. The most unethical and punishment-based training does not stem from the use or nonuse of aversive motivational stimuli but rather from incompetence. Incompetent trainers may lack the basic know-how and skill to use basic procedures humanely or to organize the contingencies and steps of a training plan. As a result of an inconsistent or incoherent organization of training events, dogs may be unable to control significant attractive and aversive motivational stimuli, thus resulting in persistent punishment, distress, and an adverse overall impact on their ability to cope.

Competent dog training is intrinsically rewarding and bond enhancing, whereas incompetent training is intrinsically punishing and bond degrading. The enhanced control resulting from successful training yields an enhanced capacity for the partnership to produce mutually rewarding exchanges that enable the partners to enjoy each other while adjusting and learning about each other. Conversely, social exchanges that result in a loss of mutual control tend to promote increased punitive interaction and conflict. The interactive conflict stemming from incompetent exchanges contributes to an increased reliance on excessive confinement and isolation, emphasis on passive head and jaw restraint, and needless distress.

The practical ends of dog training have significant welfare implications, especially for dogs trained to perform services that are inherently aversive and require significant compulsion to achieve. One cannot disclose the nature of one's training objectives to a dog in advance, nor can it appreciate intuitively the significance of its training. To some extent, the dog's innocence and ignorance with respect to the end task renders the ethical dilemma somewhat less consequential than if the dog was deliberately kept in the dark by deception and omission regarding ultimate aims and purposes. However, to the extent that the dog is an object of care, its innocence about such matters obligates the trainer, as a *humane* being, to consider thoughtfully the ethical implications of training procedures and the practical purposes for which the dog is trained. Training goals that are ultimately enslaving or harmful to a dog are inherently unethical and cruel, regardless of the means used to attain them.

One hypothetical test that can serve as a general guideline for making decisions about practical use is to ask oneself whether the dog, given a choice, would likely select the career being chosen for it. The notion that a dog might truly love to work is not far-fetched, since selective breeding has produced a staggering array of canine skills integrated with ready-made motivational systems that make their performance intrinsically rewarding. Breeding biologically prepares dogs with drives and functional capacities that are uniquely compatible with certain practical tasks while being inimical to others. Dogs are born with a set of innate threshold values predisposing them toward certain traits and action modes. These predispositions point toward activities that a dog seeks and is gratified to perform. These various preferred activities represent a core focus of competency that a dog is naturally inclined to integrate skills around. Discovering a dog's core competency and building on those interests and incentives is an important aspect of both cynopraxic and practical dog training. Integrating skills relevant to a dog's core competency serves to activate power and freedom incentives, which are typically expressed in playful activities of various kinds. The availability of these playful activities can be budgeted and made to overlap with the performance of related practical

activities of significant value to the trainer but of no particular significance to the dog, except insofar as resonating with core interests and affording an opportunity to play or the possibility to obtain other rewards. When training working dogs, the competent trainer discovers, stimulates, refines, and sublimates various innate appetites and propensities (drives) conducive to the performance of useful services in accordance with the accepted cultural and functional expectations of the breed.

Just as a competent craftsperson would not use a screwdriver in place of chisel or a wood saw to cut metal pipe, a competent trainer would not train a beagle to hunt grouse or train a Brittany spaniel to hunt rabbit. In essence, the practical trainer's work is to actualize an innate potential present in the dog for some useful activity. As a result of such training, a convergence human and canine interests dovetails, with the dog obtaining significant gratification and playful stimulation as the result of performing some valuable practical activity, thereby satisfying both the trainer's objectives and the dog's interest in play and companionship. Dogs successful in such work have an increased likelihood of being bred and thereby perpetuating the genes responsible for their responsiveness to training.

The foregoing represents the ideal circumstances surrounding the training of working dogs, whether they are used for military scouting and reconnaissance, drug and explosive detection, search and rescue, hunting, herding, and so forth—dogs work to play. Some training objectives, however, require that dogs perform work for which they are neither biologically prepared nor from which they can obtain play gratification. Training dogs for such purposes requires the implementation of means other than play to shape and render reliable the requisite repertoire of trained behavior needed to perform the service. Typically, such dogs are systematically manipulated by social encouragement together with the presentation and withdrawal of attractive and aversive motivational stimuli in the process of compelling adjustments compatible with the training objective that they would otherwise not perform. These issues raise difficult ethical questions, requiring that one weigh the cost of such training and service to the dog versus the potential social benefits that the service provides for the end client. If the social value of the service is minimal or harmful to society, it is easy to conclude that such training is inappropriate. It is sobering, though, to consider the previously mentioned Russian antitank dogs in the context of a social cost-benefit assessment. From the perspective of the Russian military and a great many Russian people faced with a mortal threat, such an end use of dogs was probably considered a tremendous social good. Indeed, the use of such dogs may have saved Russian lives, but the notion of training dogs to become living bombs is abhorrent, just as making prostitutes of adolescent children for the sake of espionage is abhorrent. In both instances, the violations of innocence and trust make such uses intrinsically inhumane. This example underscores the danger of ethical judgments weighted in the direction of social cost-benefit assessments and social consensus without appropriate consideration having been given to the cost and harm to the dog.

The line becomes even more blurred in the case of some canine services that provide a significant amount of social benefit, such as those performed by assistance and guide dogs, but involve the training of unprepared action sequences. As noted previously, in addition to reward-based training efforts, such practical training activities often require a significant amount of inhibitory training and compulsion. Unlike working dogs in which the end use is compatible with breed-typical appetites and drives, some service applications are intrinsically foreign to dogs (see Serpell et al., 2000). Dogs that perform such services do so as the result of intensive training that gradually shapes a repertoire of behaviors having little intrinsic reward value for the dogs themselves but possessing immense comfort and reward value for persons needing such assistance. Although the close interaction and companionship provided by the client-caregiver provide the dog some compensation, nevertheless such dogs would also benefit

from special compensatory stimulation consistent with their breed-typical play and work interests when not performing services, including appropriate opportunities to play and exercise—activities that the client-caregiver may not always be able to provide the dog. Perhaps what is needed is a national volunteer-type organization that would provide *assistance* to these dogs and their owners in the form of play and other outdoor activities not otherwise available to them.

There is nothing intrinsically incompatible between cynopraxic priorities and work, provided that the training process is competent and consists of bond-enhancing exchanges that improve a dog's QOL. These cynopraxic priorities stress that the working dog *team* is the result of a mutual process of adaptation conducive to belongingness, playfulness, and trust. Even relatively unnatural skills, if trained in a competent manner and gradually brought under the motivational influence of power and freedom incentives, can become the source of significant pleasure for a dog to perform.

Although practical dog training can involve behavioral objectives that are exploitive or inimical to a dog's well-being, many practical uses of dogs can be achieved in a manner that does not run afoul of cynopraxic bond and life-experience imperatives. Some authors have argued that working dogs, in principle, cannot be effective workers while living in a home as companions, suggesting that selective breeding for traits that make them good working dogs bars them from making good household companions. These sorts of general hypotheses conflict with numerous counterexamples indicating that working dogs can, and do, enjoy the QOL benefits of companionship and still remain effective workers (see Kiley-Worthington, 1990). Finck (1993), who studied the affect attunement between children and dogs, found that working and hunting dogs were generally highly receptive to a child's attunement efforts, which is consistent with the enhanced abilities of such dogs to follow human instruction.

Breeding that would so alter behavioral thresholds in ways that preemptively excluded a dog from household companionship would likely also significantly impair the dog's capacity to perform most types of cooperative work. The notion that canine traits conducive to work are incompatible with domestic life is unfounded and contradicted by common experience, since thousands of police dogs have demonstrated that they can be both good workers and welcome household companions. Many police departments in the United States use dogs that work and then go home with the officer/handler as companions. Police dogs share the risk of a dangerous job and are entrusted to make safe contact with the general public. Why, then, should they be denied the familiar surroundings of the home after their duty shift is over? How might the isolation and confinement of overnight and weekend stays in a kennel help such dogs in their work? Dogs are first and foremost companions who are also helpers, and specialized uses of canine labor that preemptively exclude them from living in a home or deny them the benefits of human companionship so that they can be made into cheap and useful "tools" raise a number of significant welfare concerns.

Means

The purposes and ultimate goals of training obviously affect the ethical assessment of the means. With the broader picture of ends in place, a more sensible discussion of means is possible. First and foremost, procedural means are employed to produce some series of immediate effects toward the realization of an ultimate goal or objective. In dog training, these means consist of a variety of manipulations involving the differential application and removal of attractive and aversive stimuli with the intent of altering a dog's behavior in some way. The ethical implications of means depend on a number of competing considerations. There is a widely held belief that attractive stimuli are of a more humane and ethical nature than aversive ones. Of course, both people and dogs share a preference for pleasure over pain; however, the ultimate significance of attractive and aversive stimuli depends not only on their momentary hedonic and emo-

tional effects but also to a significant extent on ultimate ends and the aggregate effects that such events have on the human-dog relationship and the dog's QOL. The experience of brief discomfort in exchange for the acquisition of long-term safety from pain or injury, together with increased opportunities for pleasure and liberty, unquestionably warrants the limited use of such stimulation, especially if other means are not available for producing a similar effect in a timely manner. However, using only mildly aversive or annoying procedures might be considered inhumane in situations where nothing of lasting benefit is achieved.

Motivational stimuli consist of hedonic (likes and dislikes) and incentive (needs) values. Seeking pleasure, comfort, and safety, on the one hand, and avoiding pain, loss, and risk, on the other, are strong motivational incentives regulating both human and dog behavior. Such events also exert influential excitatory (arousal) and inhibitory (calming) autonomic effects. Training consists of the response-contingent application of both attractive and aversive events in order to change a dog's behavior in some specific or general way. Applying aversive stimulation excessively, incompetently, or unnecessarily represents prima facie abusive treatment. Although the arbitrary and incompetent use of attractive and pleasurable events does not invite similar criticism, it too can be highly abusive and destructive. Since attractive incentives can be used to deceive or to obtain ends harmful to a dog or fail to obtain beneficial ends, a reliance on nonaversive procedures may be unethical in cases where the training objectives are contrary to the dog's best interests or when they result in harm to the dog that could have been averted by the use of a more effective but aversive procedure. Conversely, aversive procedures that cause significant discomfort but act as a means to some beneficial end (e.g., prevent the dog from running into the street) may confer a positive moral value to the procedure insofar as it is efficacious and achieves, on the whole, an ultimate good that could not have been achieved by nonaversive efforts alone.

When considered independently of ends, attractive events and aversive events are morally indeterminate, although the former is hedonically preferable to the latter. Consequently, on balance, if some behavioral objective is equally obtainable by attractive or aversive means, then the trainer, with due respect for the dog's preference for pleasure, is ethically bound to use attractive means rather than aversive ones. On the other hand, if some behavioral objective promising benefit to the dog is obtainable only by aversive means, then the trainer, with due consideration for the dog's well-being, is ethically obligated to use the least aversive procedure necessary. However, on the whole, the competence and confidence needed to integrate an adaptive coping style depend on a balance of reward derived from the successful control of both attractive and aversive motivational stimuli. To conceive of attractive stimuli as being intrinsically good and beneficial to a dog's welfare and aversive stimuli as being intrinsically bad and inimical to a dog's welfare is the brew of fanatics, not the fruit of science or a sincere concern for the dog's welfare. From the perspective of cynopraxic theory, punishment, especially those efforts that thwart or attempt to suppress a dog's control efforts by incompetent interference or excessive confinement or restraint, is a far more significant and serious threat to canine welfare than is the balanced use of aversive motivational stimuli in the context of reward-based training.

In practice, the decisions regarding the use of valenced motivational stimuli involve a variety of practical and ethical considerations. At minimum, for attractive and aversive events to be used humanely, the trainer must possess sufficient skill to apply them effectively for the purpose of attaining well-defined target objectives (competency factor) and possess a reasonable idea of the immediate and remote consequences of the events used, including a realistic appreciation of potential side effects. In addition to general training and behavioral knowledge, the trainer must also possess significant experience with dogs of different breeds and temperament types at various ages—factors that strongly

influence the selection and appropriateness of training procedures.

OWNER CONTROL STYLES AND WELFARE AGENDAS

Hiby and colleagues (2004) have collected and analyzed questionnaire data ostensively relevant to owner control and disciplinary styles, however, the interpretation and conclusions they present of their findings appears to belie a negative bias and agenda against the use of aversive motivational stimuli in dog training. Among these findings, they found that dogs receiving high obedience ratings from their owners were rewarded more often than counterparts receiving low obedience ratings. This finding suggests a rather obvious and straightforward implication: owners are more likely to reward obedient behavior than they are to reward disobedient behavior. That low obedience ratings were associated with a higher frequency of punishment suggests a similarly obvious implication: dog owners tend to punish disobedient behaviors and refrain from rewarding them, at least not intentionally. The authors also found a strong correlation between punishment and the relative incidence of behavior problems. That the greatest number of problem behaviors were reported by owners using the most punishment or those combining punishment and reward, yields an obvious corollary of the foregoing, just as commonsense might predict, namely, owners of problem dogs are more likely to react with punishment or a combination of aversive and attractive means in an effort to control behavior problems. In contrast, dogs showing the least number of problems would naturally tend to receive more rewarding interaction—again an obvious finding, after all what would lead a sane person to shout or cause discomfort to their dog if it were not in reaction to some undesirable behavior.

The authors also found that dogs that walked obediently on leash were more likely to be praised by their owners than dogs that pulled, a finding that suggests that obedient dogs may have received some prior inhibitory training, perhaps combining leash jerking with praise, such as a method popularized in England by Woodhouse and widely practiced in one form or another in the United States. Praise and petting in the context of inhibitory training may serve to support consequent autonomic attunement and safety. Once limits are set on pulling, reward-based exchanges can, indeed, help to maintain obedient walking habits; however, praise-alone would hardly be an adequate incentive to prevent or stop pulling by normal dogs. The notion that average dogs might be trained by their owners to walk "at heel" in public by using a praise-alone technique is highly improbable. Practical experience dictates that a combination of techniques incorporating both attractive and aversive motivational incentives fitted to the individual dog's needs works best for controlling leash-pulling excesses and other behavioral complaints resulting from the incessant canine appetite for drive-activating stimulation and novelty that most dogs show when outdoors.

The authors appear to assume that the increased reward received by obedient and well-adjusted dogs carries the necessary implication that well behaved dogs are made that way by means of reward-alone methods—an approach that they claim was practiced by an astonishing 20% of their owner respondents. They also report that nearly 10% of dog owners used a punishment-only method of control. Logically, it is difficult to consider how reward-only or punishment-only training might be implemented, since by definition the contingent withdraw or withholding of an attractive event is punishing, just as the contingent withdraw or omission of an aversive event is rewarding. How an owner might be able to carry on everyday exchanges with the dog that only resulted in reward or punishment is hard to imagine. In general, the findings reported by Hiby and colleagues point to the obvious conclusion that highly excitable, impulsive, and disobedient dogs are more likely to receive more punishment than dogs considered by their owners to be relatively calm, well-behaved, and obedient to command—dogs that are more likely to become the object of affectionate appreciation. Here is the real welfare implication of their study,

viz., problem dogs are at greater risk of becoming the object of owner frustration, anger, and abuse.

Most dishearteningly, however, after acknowledging that their findings lacked causal significance (i.e., correlations of this sort do not prove cause-effect relationships), the authors nevertheless go ahead and treat them as though they were causally significant, concluding that reward-only methods represent "a more effective and 'welfare-compatible' alternative to punishment for the average dog owner" (2004:68). Instead of considering the most obvious and plausible implications of their findings, the authors draw upon a far less plausible generalization in order to promote what appears to be for them a foregone conclusion: aversives are *bad* for dogs and *good* owners and trainers should not use them. The authors appear to be so swayed by their heartfelt convictions and morality-speak regarding the "welfare-incompatible" implications of aversive training techniques that they entirely neglect to consider the most reasonable alternative hypothesis, namely, that aversive control efforts might actually offer significant welfare-compatible benefits. The oblique tone and pejorative commentary contained in this study also warrants mention. Not only is such diatribe demeaning with respect to the trainer's art and tradition, the particulars of the commentary are generally in conflict with a large body of practical and scientific evidence indicating that aversive motivational incentives can be effectively used in the context of reward-based training to enhance the human-dog bond and improve the dog's QOL.

The question is not whether aversives should or should not be used in the context of reward-based training; aversives *are* an integral aspect of competent dog training and aversive procedures will surely remain an instrumental and standard part of the dog trainer's practice (see Delta Society, 2002). What is more likely to change in a beneficial way is the relative reward-to-punishment ratio, the severity, and the frequency with which aversive procedures are used—a fairly constant trend that is evident in the tradition of dog training as well as in contemporary improvements and progress in training methodology and skills. The debate would be far more constructive if it focused on how such procedures might be most effectively and efficiently used to minimize adverse side effects while maximizing potential welfare benefits in the context of reward-based training. The humane use of dog training methods depends on trainer competency, which, in turn, depends on suitable experience and reliable scientific information—not the imposition of moralistic agendas opposed *on principle* to the use of aversive procedures in dog training.

Anthropic Dominance Ideation, Perceived Power, and Control Styles

Bugental and colleagues (1993) have studied the dominance dynamics between caregivers and children. This work provides a number of useful insights into dominance and its destructive influences on dependent familial relationships. The attribution of dominance to children (and dogs) appears to be the expression of an insecure cognitive bias affecting an individual's perception of the power dynamics between themselves and dependent others. The power ideation and narrative used by persons with low perceived power are often employed to rationalize the abusive behavior-control tactics that such low-power persons are prone to employ in order to control dependents. Low-power parents interpret challenging behavior as being determined predominantly by causes under the child's control (e.g., stubborn or dominant attitude) rather than being the result of causes under proactive parental control. The researchers found that, while observing child behavior perceived as challenging, low-power parents filter and interpret what they see in terms of threatening implications. The reactive bias shown by such parents is indexed by changes in autonomic activity consistent with defensive arousal and a vulnerability to form nervous/insecure attachments. In contrast, high-power parents perceive the causes of challenging behavior to be predominantly under proactive control and remain in a state

of autonomic balance while viewing challenging child behavior—a profile consistent with a capacity for autonomic attunement and the formation of secure attachments.

In addition to autonomic differences indicative of a reactive coping style and defensiveness, low-power parents show significant changes affecting dominance ideation when operating under the influence of cognitive load. Under cognitive load, low-power parents tend to exaggerate the power disparity between themselves and their children, tending to rank the child as being more dominant, and justifying deprivational, emotional, and physical abuses toward the child as *self-defense*. However, when these same low-power parents are not under the pressure of cognitive load, they appear to adopt an opposite attitude and estimation of social power relative to the child, tending to rank themselves as possessing more power than the child. These power-dominance vacillations inject a disruptive dynamic of ambivalence that increases the risk of gratuitous retaliation against the child (Bugental et al., 1997). Similar power dynamics appear to filter the way low-power owners and behavior modifiers interpret challenging dog behavior.

Whereas low-power behavior modifiers dwell on causes beyond their control, high-power behavior modifiers focus their attention and training efforts on matters that are within their reach and ability to change. The prominent findings of Bugental's research can be summarized and extended to behavior modifiers, as follows:

1. Low-power behavior modifiers are more likely to indiscriminately interpret challenging or oppositional behavior as a power contest beyond the reach of proactive behavioral interventions.
2. Low-power behavior modifiers are more likely to engage in highly intrusive or aversive deprivational, emotional, or physical practices.
3. Low-power behavior modifiers are more likely to interpret challenging and oppositional behavior in terms of malevolent social power intentions.
4. Low-power behavior modifiers unsure of their authority and power to control a dog in proactive ways are more likely to resort to coercive emotional tactics, abusive force, or deprivational strategies.
5. Low-power behavior modifiers tend to justify highly intrusive and aversive training activities by appealing to self-defense and public safety.
6. Low-power behavior modifiers are more likely to interpret and respond to the uncertainty of ambiguous situations as threats, causing them to respond with inconsistent and reactive punishment.

Recurrent cycles of passive resentment followed by reactive and abusive power assertions appear to activate social ambivalence and entrapment dynamics, perhaps inoculating the dog with anxiety, irritability, and social withdrawal (dispersive tensions) or activating incompetent and reactive autoprotective strategies for coping with the low-power owner's inconsistent behavior and uncontrollable mistreatment. Exposure to cyclical patterns of passive resentment and arbitrary social and emotional deprivation, excessive confinement and restriction, and uncontrollable physical punishment may infuse social interaction between the dog and offending family members with a high degree of conflict, uncertainty, and mutual mistrust (distrust), perhaps causing the children and the dog alike to adopt preemptive and autoprotective strategies for coping with the reactive power shifts governing the low-power owner's control efforts. Alpert and colleagues (2003) found that children of parents diagnosed with depression (low-power state) and comorbid anger attacks were more vulnerable to develop post-traumatic stress disorder (PTSD) or increased aggressive behavior than were children of parents diagnosed with depression without comorbid anger attacks. These patterns of increased autoprotective behavior of children appear to parallel the reactive coping styles shown by dogs exposed to a history of maltreatment and abuse by low-power owners. The same research group also found that children of parents with early-onset depression were more vulnerable to develop a variety of psychological and social disturbances (e.g., delinquency and aggression) than were children of parents with late-onset depression

(Petersen et al., 2003). These psychiatric findings suggest a possible linkage between dog owners affected by depression (low-power state) with anger and an increased risk of reactive/impulsive aggression and other challenging behavior problems in dogs—a hypothesis that might be used to test and falsify the antipredator/autoprotective account.

Low-power individuals appear to be prone to behave in ambiguous or impetuous ways toward the dog or send social messages having passive-aggressive implications that may contribute to social ambivalence and reactive adjustments. A dog owner that abruptly grabs a sleeping dog around its head to give it a firm kiss on the mouth is not performing an act of loving appreciation, but is tempting fate with arrogance standing on the shoulders of ignorance. The evident abandonment of common sense at such times is the sort of thoughtless and inconsiderate action that has frequently resulted in devastating bites. As demonstrated in the case of children (Bugental et al., 1999b), dogs also appear to *tune out* ambiguous social signaling. Unfortunately, in human-dog interactions, the disengagement of social and attentional resources in response to ambiguous social interaction may trigger autonomic arousal, executive, and physiological functions coordinated and attuned by selective and sustained attention.

The finding that persons prone to low-power estimations are vulnerable to distort and shift their perception of relative control depending on cognitive load appears to question the validity of questionnaires and self-reports for estimating the efficacy of aggression-treatment programs. Low-power owners, depending on the quality of emotional support provided during counseling, may subsequently judge their personal power over the dog in a highly inflated or deflated way. Consequently, the estimates of behavioral improvement that such owners may attribute to medications or behavioral treatments may be confounded with changes in their dominance ideation and perception of control rather than effects specific to the intervention, which may not actually exist (false positives) or may exist but are not recognized (false negatives). The work by Bugental and colleagues has obvious implications with respect to providing a theoretical framework for studying the effects of owner control styles on the differentiation of adaptive and reactive coping styles. Study of owner control styles would be relevant to cynopraxic theories of social aggression and separation distress, and might also have general implications for understanding how proactive and reactive behavior is shaped. In addition to needing a questionnaire validated for the detection and assessment of low-power and high-power dog owners, such research would likely benefit from a design in which between-group comparisons could be made of dogs meeting the criteria of stable versus unstable extraversion. A similar sequestering of dogs according to criterion of stable and unstable introversion might also be performed. How stable and unstable extraverts and introverts progress under the influence of owners with high-power or low-power control styles may reveal interesting relationships between the stable-to-unstable continuum and the owner's control style. The study might be revealing with respect to dynamics mediating adaptive and reactive coping styles and factors contributing to the integration of secure and insecure attachments. Topál and colleagues (1997), for example, have found that the problem-solving ability of dogs is inversely related to the strength of the dog's attachment to the owner (i.e., problem-solving abilities decrease as attachment measures increase), which is consistent with the notion that dogs with insecure attachments would be more vulnerable to interactive conflict and a reactive coping style. Finally, such research might be readily performed in the context of an animal shelter with the human questionnaire and canine personality testing performed as a routine part of the adoption process.

Power-dominance Ideation and Treatment Protocols

The power-dominance motivation attributed to canine domestic aggression is widely accepted as a leading cause of intrafamilial aggression. Appeal to social rank as a cause of aggression is a central theme guiding much of

the applied and popular dog behavior literature, with most authors rehashing the narrative account or tweaking it to justify their particular dominance-oriented treatment program. However, instead of helping family members to understand the causes of dog aggression, such emphasis on dominance and rank may serve only to perpetuate a malevolent interpretation of canine intent and purposiveness that places undue and inappropriate focus on causes that are predominantly beyond an owner's control and rarely significant for the treatment of domestic aggression problems. Instead of interpreting the etiology of intrafamilial aggression problems and their treatment in terms of adversarial hierarchical dynamics, counseling and training activities are better served by focusing on the antecedent events and establishing operations specific to interactive exchanges triggering reactive behavior, insofar as these behavioral elements are accessible and subject to change by means of social exchange.

The dominance narrative not only has obscured the causes of aggression problems but has also resulted in a considerable amount of conceptual confusion that continues paralyze research, concealing far more than it reveals by way of a simplistic explanation regarding the causes of aggression. The anthropic dominance bias frames an excessively myopic and simplistic perspective on canine social behavior, giving rise to circular diagnostic labels and treatment rationales based on the dominance narrative. The effects of this misconception are not just of theoretical interest, because the dominance narrative and unfounded assumptions arising from it are used to justify a variety of highly intrusive and aversive practices in the name of rational therapy. The dominance narrative frames autoprotective and challenging dog behavior in a manner that contributes to the use of abusive emotional deprivation, aversive physical control and restraint tactics, and unproven pharmacological and surgical procedures. A leading cause of ineffectual management and treatment is the habitual targeting coercive tactics at quashing the "dominant" dog's attitude or perception of rank. The default use of drugs to treat such problems is especially problematic because it appears to shift the domain of causation from the dog's attitude to its physiology—a domain of causality that is sufficiently vague for both the owner and the behavior modifier to promote magical thinking about the efficacy of such treatments.

Although some dogs with severe aggression problems may be victims of inadequate socialization and training, their care and training are frequently not that much different from the way many millions of other dogs are treated that do not develop aggression problems. Given the notable lack of (1) formalized-threat sequencing, (2) the severity of attacks, (3) the explosive and situational inappropriateness of attacks, (4) the benign nature of the provoking challenges or threats, and (5) the general incompetence exhibited by the aggressor and the victim, diagnosing such attacks as "dominance aggression" seems akin to pounding a square peg into a round hole and calling it a perfect fit. Most dogs with serious aggression problems do not appear to have been victimized by physical punishment. Instead, aggression seems to emerge under the influence of a genetic predisposition and the incubation of nervous or insecure attachments, interactive conflict and tensions, entrapment dynamics and social ambivalence, adverse dietary and environmental conditions, inadequate exercise and play, excessive confinement and restraint (isolation), suboptimal attention and tactile stimulation, autonomic dysregulation, or the absence of appropriate training and play. In short, as the result of an emergent reactive coping style, selective attention and impulse-control capacities may be degraded and impaired, causing the dog to become increasingly inattentive, uncooperative, aloof, or impulsive—attributes often claimed to be evidence of dominance problems.

These various issues stress the danger inherent to approaches that take anthropic ideas and symbols such as *dominance* and reify them into substantive causes or proximate relations in order to rationalize intrusive and aversive behavior-change procedures that ironically are not too dissimilar from the *real* causes of aggression. A substantive body of

human research indicates that perceived power and dominance ideation promotes a number of cognitive and behavioral effects on how parents, teachers, and caregivers cope and respond to the challenging behavior of vulnerable dependents (Bugental et al., 1993, 1997, and 1999a), findings that are directly relevant to how family members and professionals cope with the management and treatment of problem canine behavior. The designation of low perceived power or high perceived power is based on the relative importance that owners place on accessible and controllable behavioral causes versus causes that are predominantly under a child's control or causes that are perceived as being uncontrollable by both a dog and its owner (e.g., disease model). For example, the attribution of stubbornness as a cause of uncooperative behavior is an indicator of low perceived power, since the lack of cooperation is perceived predominantly as being under the control and intent of a stubborn dog or child. Similarly, consultants and trainers operating under the influence of a low-perceived-power construct may attribute a dominant attitude and other highly speculative causes to explain the etiology of aggression and challenging behavior. The tendency to attribute attitudinal causes associated with the dominance ideation may be linked with excessively intrusive or aversive training strategies or reliance on unproven nutritional or psychopharmacological protocols.

Low-power owners (like low-power parents with regard to their children) tend to explain their dog's misbehavior in terms of causes that lie outside of their control or understanding. The low-power behavior modifier may perpetuate this perception by searching for causes of the problem in the dog's attitude or distant history that resonate with the anthropic dominance myth. From the very outset of such therapy relationships, the dog's behavior may be framed in terms of power-ascendant motives and a preoccupation with finding ways to leverage power and control over it. Instead of highlighting how social ambivalence and inconsistent control efforts may have contributed to the problem, the counselor may assign an attitudinal cause to behavior and give the owner a diagnostic label with which to justify abusive deprivational and emotional treatment procedures that resonate with and confirm the owner's powerlessness. Unfortunately, by locating the causes of aggression in a dominant attitude or perception of rank, the trainer/consultant may only succeed in strengthening the owner's private distortions and belief, thereby perpetuating problematic power-dominance dynamics. The seeking and getting of a diagnostic label may tap a primitive urge to possess a magical name, causing a low-power owners or supplicant to seek out the wisdom of a low-power behavioral hierophant, hoping for a revelation, a magical name, a vision of the future, a potion, or a set of rituals with which to placate the mysterious forces causing the dog to misbehave. With the possession of a name, the low-power owner may feel empowered by virtue of the arcane scientific authority and significance attributed to it. Obviously, the practice of diagnostic labeling is extremely problematic, and especially so when the name shifts from a merely descriptive significance to causal significance; that is, the diagnostic label is no longer used to specify a collection of symptoms but now implies explanatory power to identify a physiological or phylogenetic cause. The interpretations used by low-power behavior modifiers are often little more than descriptive platitudes and elaborate myths that lack coherent causal significance. Unfortunately, the nominal fallacy (i.e., confusing naming with explaining) is widely committed in the context of treating canine adjustment problems.

The autoprotective perspective is more parsimonious and consistent with the collection of known facts than is the dominance account (see *Antipredatory Strategy and Autoprotection versus Dominance* in Chapter 8). Although an oversimplification itself, the antipredator hypothesis is a much less harmful over simplification than is the dominance myth. The antipredator model puts the owner in an instrumental role, thereby correctly emphasizing that human-dog interaction and, in particular, human action, rather than malevolent canine intent and power-dominance motivations, are the primary causes to

blame (if any) for domestic aggression; dogs, like most prey animals, rarely go out of their way to instigate aggressive contests, at least not without significant agitation and due cause for such anomalous behavior. In general, dogs are not in need of therapy to modify a distorted "perception of rank," but the dog and its owner may need to learn how to build relations conducive to cooperative exchanges and autonomic attunement while integrating secure social and place attachments. Like a dog living under social ambivalence and dispersive tensions, an abused child may also adopt an antipredatory orientation toward the parent and acquire the habits of a frightened prey animal but secretly harbor or surreptitiously act out fantasies of cruelty on the dog. As the child enters into power relations with other children and the family dog, the parent's predatory model may become apparent in the child's abusive and ambiguous relations with the dog, perhaps causing him or her to become increasingly exploitive and intrusive toward the dog while extracting pleasure from its distress and victimization. Children that treat dogs abusively and communicate ambiguous affection and play signals might, therefore, reflect some of the same dynamics expressed in the reactive behavior of the dog. The child and the dog may mirror and express similarly reactive behaviors, ambivalence, and impulsivity flowing from exposure to the same parental emotional or physical abuse.

The relationship formed between the owner and the behavior modifier appears to exert a profound influence on the owner's perception of control, depending on the nature of the causes (accessible versus inaccessible) attributed to the problem, and the treatment strategy selected to resolve it. The typical treatment strategy adopted is based on either a proactive open-stance orientation directed toward accessible causes or a reactive closed-stance orientation directed toward inaccessible causes (i.e., relatively uncontrollable or unknown). A major ethical and welfare consideration recommending the autoprotective account of canine domestic aggression is that it avoids evoking anthropic dominance ideation and the biased framing of challenging dog behavior in terms that encourage the use of abusive or ineffectual treatment programs aimed at coercing a change in the dog's "dominant" attitude or perception of rank. The dominance narrative is widely associated with the use of abusive emotional deprivation, traumatizing physical punishment and restraint tactics, and unproven pharmacological interventions.

The cynopraxic approach emphasizes counseling and therapy aimed at facilitating improved attention and impulse control, integrating affectionate and playful relations, supporting autoinitiated behavior and emotional autoregulation, and promoting a gratifying life experience—changes that naturally reduce the risk of domestic aggression. An important goal of cynopraxic counseling and therapy is to empower the owner with basic skills and dog sense to promote a fair balance of control and appreciation of the dog's needs, while improving the dog's ability to engage in interactive prosocial exchanges rather than resorting to reactive antisocial behavior. In particular, play represents a potent tool for adjusting the social imbalance contributing to impulsivity and reactive behavior. Comprehensive cynopraxic training and behavior-therapy efforts serve to promote changes that facilitate a functional equilibrium at virtually every level of behavioral organization. These social changes are brought about by the integration of secure attachments and an enhanced QOL that benefits both the dog and the family members.

Problematic Trends and Obstacles to Adaptive Coping and Attunement

In addition to avoiding training procedures that are needlessly aversive, cynopraxic trainers avoid procedures that intrude excessively upon a dog's freedom incentive (see *Hydran-Protean Side Effects, the Dead-dog Rule, and the LIMA Principle*). Training efforts that inappropriately restrict a dog's ability to initiate goal-directed behavior not only adversely impact the dog's QOL but often do so without contributing any real therapeutic benefit. For example, inappropriate restraint or isola-

tion, pointless deprivation procedures, intrusive rules of interaction, and tedious extinction and training rituals may be of little positive benefit with respect to training goals but impose time-consuming hardships on the owner, impede the bonding processes, and impair the dog's ability to adjust, perhaps making the problem worse. Although highly intrusive procedures do not generate physical pain, they can produce significant *emotional pain* and distress while augmenting interactive conflict.

Pharmacological Control of Behavior

In recent years, the introduction of a medical model of dog behavior has led some practitioners to treat adjustment problems as mental disorders having physical causes and often to emphasize the role of disease as the underlying cause of behavior problems (Mills, 2003). Although the medical model is not entirely without merit, as some valid parallels exist between certain psychiatric disorders and canine behavior disorders and undoubtedly some behavior disturbances are the result of disease, overly speculative assumptions, problematic diagnostic labels, and an excessive reliance on psychotropic drugs based on rationale borrowed from human psychiatry serve only to compound the current puzzlement regarding the etiology and functional significance of canine adjustment problems. In addition to emphasizing disease etiologies and the importance of drugs to treat behavior problems, many practitioners who stress the medical model claim special authority pertaining to matters of diagnosis whereby the "physical" causes of the problem are purportedly identified, usually by means of speculative inferences from emotional and behavioral signs. These putative but unproven physical causes are then targeted with various medications believed to mediate a resolution of the problem. Unfortunately, the various inclusion and exclusion criteria used to make behavioral diagnoses and related drug-treatment decisions tend to cause referring professionals and owners to defer treatment until the canine adjustment problem reaches a form that threatens the dog with relinquishment or euthanasia, rather than initiate behavioral treatment at the first sign of a problem. The pharmacological approach resonates with the low-power owner's basic assumptions, placing the causes of the dog's adjustment problems beyond the scope of conventional training and socialization efforts. The adjustment problem is encapsulated within an involuntary subdomain of physiology that places it outside of the dog's voluntary control and prevents its resolution without the help of drugs. In contrast, the cynopraxic approach views the physical changes to brain that mediate disturbance as the result of the accumulative effect of conflictive social exchanges and reactive adjustments in response to environments chronically lacking sufficient predictability and controllability to promote an adaptive coping style. Conversely, by changing interactive habits of social exchange to promote interactive harmony in combination with appropriate QOL changes that support the dog's needs, the physiological causes of disturbance are replaced by physiological changes conducive to adaptive optimization and social adjustment.

Although drugs are potentially useful in some refractory cases, the current state of the art remains investigational, and the ultimate benefits of drug therapy are uncertain, especially with respect to the control of domestic aggression problems (see *Pharmacological Control of Aggression* in Chapter 6). Even in the realm of human psychiatry, the efficacy of the most commonly prescribed mood-altering drugs used to treat anxiety and depression disorders has been questioned. Kirsch and colleagues (2002; see also Kirsch and Sapirstein, 1998), for example, who performed an extensive meta-analysis of treatment data submitted to the U.S. Food and Drug Administration (FDA) between 1987 and 1999, found that 80% of the clinical response of humans to six commonly prescribed antidepressants was duplicated in placebo control groups, suggesting that the selective serotonin reuptake inhibitors (SSRIs) tested may have little clinical effect separable from that of placebo. A remarkable neuroimaging study of human patients treated for depression has shown that placebo responders and fluoxetine responders

show similar changes in glucose metabolism in specific cortical and limbic areas, concluding that the "administration of placebo is not absence of treatment, just an absence of active medication" (Mayberg et al., 2002). In addition, the study revealed that the two groups responded differently to fluoxetine, with the drug producing specific changes in the hippocampus and brainstem of fluoxetine responders after 1 week of therapy that predicted a long-term response to the medication. Responders also showed a switch effect in response to drug therapy that resulted in an initial elevation of posterior cingulate metabolic activity followed by a decrease and then a gradual increase over the 6-week period of therapy—a pattern of change not exhibited by placebo responders. These distinct metabolic changes that differentiate responders from nonresponders suggest that tympanic temperature fluctuations might be present among dogs that could be tracked to help identify serotonergic responders from nonresponders (see *Functional Lateralization and Tympanic Temperature* in Chapter 9).

Although the FDA appears to enforce strict standards of efficacy to gain approval on certain classes of drugs, there appears to be a troubling double standard with respect to others, perhaps including the level of stringency applied to psychotropic drugs such as SSRIs. However, the most egregious and disturbing example of a double standard used to evaluate drug efficacy is the special and protected status afforded to homeopathic substances, described by one FDA representative as "kinder, gentler medicine" (Stehlin, 1996). Incredibly, homeopathic remedies are approved as drugs without meeting the rigorous standards of proven efficacy set for other drugs issued FDA approval. A meta-analysis of 89 studies using homeopathic substances to treat various medical conditions concluded, "Our study has no major implications for clinical practice because we found little evidence of effectiveness of any single homoeopathic approach on any single clinical condition" (Linde et al., 1997:840).

With regard to serotonergic antidepressants and dog behavior problems, even when apparently efficacious in the short term, aggression-controlling medications are unlikely to succeed in the long term without the support of complementary behavior therapy. The therapeutic use of social placebo is acknowledged as a valuable tool in the cynopraxic treatment of behavior problems (see *Social Placebo* in Volume 2, Chapter 10), but the administration of costly psychotropic drugs that exert potential health-threatening side effects for the sake of questionable benefits that do not rise above placebo alone raises serious ethical and welfare concerns. In any case, no drug or combination of drugs currently available can provide the sweeping range of dramatic and subtle balancing and integrative effects that are mediated by cynopraxic training and play therapy (see *Modulatory and Unifying Effects of Play* in Chapter 6). Comprehensive cynopraxic training and therapy efforts promote changes that facilitate a functional equilibrium at virtually every level of neural organization. Cynopraxic therapy is based on the assumption that social exchange promoting adjustments conducive to an adaptive coping style and secure attachments serve simultaneously to mediate physical alterations of the neuronal substrates mediating social ambivalence and reactive behavior. In particular, play therapy represents a potent tool for adjusting autonomic imbalance and reducing the allostatic load perturbing the complex feed-forward trafficking of neuronal networks that contribute to the etiology of adjustment problems (see *Cynopraxis: Allostasis, Adaptability, and Health*).

When drugs are used to manage intractable behavior problems, the goal should be to alleviate allostatic load and to promote neurobiological changes conducive to social affiliation and playfulness. Pharmacological efforts used merely to suppress undesirable behavior seem wrongheaded, violate the dead-dog rule, and are intrinsically problematic with respect to the basic bond and QOL tenets of cynopraxis. Dogs that engage in autoprotective behavior usually do so out of emotional extremis associated with chronic stress and allostatic load. Using behavior modification, restraint and isolation, emotional deprivation, or drugs to suppress undesirable behavior, without alleviating the underlying social and environmental causes

hindering a dog's ability to cope adaptively, violates basic welfare principles (Broom and Johnson, 1993).

Mechanical Suppression of Behavior

The restrictive loss of freedom imposed by excessive crate confinement is especially prone to cause harm in cases where the procedure is used in the absence of constructive training efforts; that is, where crate confinement is made into a way of life or a *steel straitjacket* for the purpose of preventing some undesirable behavior by mechanically suppressing all behavior. The word *crate* carries the implication of a temporary container used for the purpose of stowing an animal away, whereas the word *cage* has the added onus of being a permanent place of restrictive confinement used to control an animal's behavior, particularly an animal regarded as dangerous and untrustworthy. A cage serves to isolate and restrain an animal in a way that makes it constantly available for various exploitive purposes that are generally performed against its will, such as a spectacle for public viewing in zoos, for entertainment on a stage, or as an object of scientific investigation. Whereas a dangerous wild animal might be briefly crated for transport or medical treatment, its permanent place of confinement and isolation from other animals and people is a cage. In contrast, domestic animals are *housed* in pens, coops, stalls, and so forth, depending on the needs of the species and the uses made of the animal. In the case of dogs, long-term confinement generally involves the use of a kennel and adjoining run appropriate to the dog's size, an arrangement that gives the dog access to both indoor and outdoor environs to rest or move about freely and to eliminate away from its sleeping and eating areas. When a dog must be kenneled on a long-term basis, at a minimum the arrangement should include the company of another dog, preferably of a similar size, friendly disposition, and a compatible same or opposite sex companion. In designing and managing environments used for animal confinement, appropriate consideration should be given to making the living space compatible with species-typical social predilections and group-organizing tendencies. Of critical importance for the housing of dogs is the provision of adequate opportunities to engage in pack-coordinated activities, which require access to large open areas for social interaction. In the case of a dog living in a home, putting the dog in the backyard alone is inadequate with respect to social needs—space alone does not confer significant benefit. Social activity needs are nicely satisfied within in the home by the combination of daily training, tug-and-retrieve play, and neighborhood walks.

Many advocates of long-term crate confinement claim that dogs are phylogenetically preadapted to live in a crate. These conclusions are based on various fallacious assumptions derived from inappropriate comparisons with the use of dens by wild canids and feral dogs. In reality, a crate has far more in common with a trap (or grave) than it does with a den. Further, a den actually has far more in common with a home, the natural environment of a dog, providing access to communal indoor and outdoor living spaces via a two-way door. An obvious distinction between a den and a crate is physical entrapment, isolation, and inescapability. While the den provides the mother with the seclusion and security that she needs to deliver and care for her young, it does not restrict her freedom of movement, as the crate does. Instead of providing a safe environ for her young, the crate serves the express purpose of separating the dog from social attachment objects. Further, instead of promoting comfort and safety, the inescapable exclusion imposed by crate confinement appears to confer an increased vulnerability for disruptive emotional arousal and insecure place attachments. Most puppies and dogs show a high degree of aversive arousal when first exposed to crate confinement, which is consistent with the foregoing comparison. After learning that the crate is inescapable, however, dogs appear to treat the crate in a paradoxical manner analogous to persons affected by the Stockholm syndrome (Ochberg and Soskis, 1982); that is, they appear to form strong attachments with

the crate, which becomes the place they identify as home.

The primary motivation governing the use of crates is similar to the reason certain wild animals are isolated in cages; viz., a dog's freedom is perceived as representing some sort of threat or risk, usually in association with destructive habits or elimination problems. The daily ritual of cajoling and luring the dog into the crate may also gradually result in the dog acquiring a growing mistrust toward the owner, as reflected in its refusal to cooperate in other ways not directly related to confinement. The widespread practice of routinely caging a dog at night and then again during the day for periods totaling 16 to 18 hours (or more) is an extremely problematic practice that should not be condoned or encouraged, because it probably underlies the development of many adjustment problems, including aggression.

For many pet trainers, pet-trade breeders, and like-minded veterinarians, caging is frequently promoted as a humane alternative to more time-consuming and skill-intensive training efforts. Although crate confinement can be a useful asset when integrated into a competent training program, to expose a dog repeatedly to 16 to 18 hours of daily caging makes no sense. The fact that a dog can survive many months of such solitary confinement in a space barely big enough for it to turn around is testament to its flexibility. In addition to crate confinement, various devices are used to supplement intrusive control efforts, such as muzzles used to restrict barking, thereby extending mechanical control over the dog's vocal behavior while it is in the cage. In other cases, owners use various behavior-activated collars designed to deliver a deterrent spray or electrical charge to control undesirable behavior while the dog is inside the crate. To restrain compensatory excitability and impulsivity, some ill-informed advisers might further recommend that the owner stop all play activities, especially tugging and roughhousing. To complete the picture, the owner may be sold on homeopathic remedies and vitamin supplements, fragrant odors and pheromones, or flower essence drops put in the dog's water to help reduce its stress!

Cynopraxis: Allostasis, Adaptability, and Health

At every step in a dog's ontogeny, predictive relations are refined and integrated into a base of genetic and experiential *prior knowledge*. These predictive relations are organized to promote stability through change, referred to as *allostasis* (Sterling, 2004). Allostatic adjustments enable dogs to anticipate and avoid future risks to stability, thus enhancing adaptive efficiency by responding to predictive signals. The genes that regulate neuronal activity depend heavily on experience for the information needed to maintain the brain's functional stability and capacity for coping proactively with change. The feed-forward unfolding of genetic information via experience-dependent gene activation and suppression is consistent with the notion that regulatory genes are responsive to positive and negative prediction-error signals. Consequently, causing neuronal activity to increase or decrease results in the production of structural proteins and enzymes, and thereby alters the neurophysiology in the process of mediating allostasis (Sterling and Eyer, 1988). Thus, the process of emergent individuation is seamlessly interwoven into a multitude of neurobiological changes that mediate cognitive, motivational, and behavioral adjustments. During such accommodation and allostatic change, the activation of neural protein synthesis and synapse building serves to integrate predictive information into the physical substance of the organism, leading to far-reaching benefits or harm influencing not only behavioral adaptation but also biological adaptation. By such means, *knowledge* acquired by experience is directly integrated into the neurobiological phenotype from where it exerts numerous adaptive and maladaptive effects on the developing organism (Kolb and Whishaw, 1998).

Acute stress is triggered in response to the detection of discrepant events that exceed the normal *safe* range of accustomed variability in combination with a perception of uncontrollability; that is, stress is a biological response to the violation of expectancy or a failure to establish predictive control over significant motivation events. Such events elicit intense state arousal, active vigilance, and increased

action readiness in anticipation of reactive emergency or defensive adjustments. Thus, chronic and uncontrollable challenges (loss of comfort), threats (loss of safety), and unconditioned aversive events mismatching prediction-control expectancies promote stress and allostatic load that adversely affect a dog's adaptability. Chronic exposure to aversive conflict situations perceived as uncontrollable tends to become increasingly problematic when they are also inescapable. Allostatic load associated with social ambivalence and entrapment is hypothesized to orchestrate widespread neuronal changes and emotional disturbances that adversely affect selective attention and impulse control.

Under social and environmental circumstances where a balance of predictive exchange is lacking, the ensuing instability and allostatic load make the work of adaptation increasingly costly. A failure to integrate a mutually satisfying household relationship based on predictable and controllable relations is not only disruptive at the level of social exchange—the consequences of such influences impact at various levels of a dog's biology and may gradually impair its capacity to adapt. According to cynopraxic theory, many maladies affecting canine health and well-being are traceable to dis-ease associated with chronic interactive conflict and compensatory allostatic load adversely impacting critical biological systems necessary to sustain health and survival fitness (see *Immune Stress and Cytokines* in Chapter 6 and *Stress, Thyroid Deficiency, Hypocortisolism, and Aggression* in Chapter 8). As such, cynopraxic therapy serves to promote both behavioral and biological stability by mediating changes that reduce interactive conflict and promote mutual appreciation and interactive harmony while enhancing the human-dog bond and improving the dog's QOL. The capacity of cynopraxic therapy to promote beneficial changes depends on the integration predictive control relations mediated by social exchange and transactions governed by a principle of fairness promoting mutual reward, cooperation, and affectionate playfulness between interactive partners around points of common interest and potential conflict.

Hydran-Protean Side Effects, the Dead-dog Rule, and the LIMA Principle

Aversive procedures are legitimate and valuable tools for controlling undesirable behavior, but such techniques can be rapidly debauched into a form that substantially complicates matters. Technically, punishment results when established control expectancies are disconfirmed, for example, when the trainer discontinues an attractive or aversive contingency. Punishment occurs when the dog recognizes that some previously successful action no longer controls the occurrence of some attractive or aversive event. Severe and sustained aversive stimulations in the absence of options to escape (e.g., beating) are of no use in dog training and for whatever reasons such nasty actions are performed they are likely to foster a far worse problem.

Just as chopping off the mythical Hydra's head only caused her to sprout more monstrous and threatening replacements growing out of the severed stump, the use of inappropriate physical punishment, restraint, and manhandling may only serve to stimulate autoprotective behavior and initiate various unanticipated vicious-circle effects. In such cases, the escalation of conflict and aversive arousal evoked by severe physical punishment may cause difficult behaviors to transform into even worse forms, especially in cases where the root causes of the problem are left unresolved. Homer's story of Proteus illustrates other aspects of potential harm wrought by inappropriate punishment and interactive conflict. For ancient seekers wishing to foresee the future, the water divinity had to be seized and held tightly as he morphed through a frightful array of threatening forms, until he finally gave in and returned to his normal form to give prophecy. The myth has obvious positive implications related to the constructive use of response prevention and blocking techniques, but more importantly with respect to the present topic, the myth resonates symbolically with the adverse effects of interactive struggles and tensions around points of conflict where the future is left uncertain until the conflict is resolved. Actions that emerge in the context of persist-

ent conflictive exchange are often highly reactive and pose many significant training challenges and risks. Further, as a result of a history of contentious interaction, dogs and people may gradually lose their capacity for mutual attraction and tolerance, becoming increasingly ambivalent, intolerant of uncertainty, and reactive toward the ordinary losses and risks associated with social exchange. Instead of engaging in friendly cooperation, the owner and dog may engage one another as adversaries in the process of morphing a veritable pantheon of adjustment problems out of the toxic conflict dynamics that bind them together.

All variation in canine social behavior develops in the context of coping styles emerging in various ways around interactive conflict. As such, the intersection of human and canine control vectors define the field of interactive possibility. Only by working through conflict by holding protean advantage-seeking efforts at bay and by opening a space of fair exchange and mutual appreciation around conflict situations can the other be perceived as a cooperator rather than a dominator or exploiter. With the restoration of *normal exchange*, the unifying relations and governance needed to promote an adaptive coping style can be pursued as a harmonious social space is extended over the field of conflict situations.

Despite obvious limitations and risks, aversive procedures are a necessary aspect of dog training and behavior-problem solving that cannot be neglected or substituted for (e.g., by drugs) when competent inhibitory control over highly motivated behavior is being established. These procedures are of great value in the context of basic training, the treatment of adjustment problems, and the integration of secure attachments. To maximize the benefits and to minimize the adverse effects of training procedures that compel dogs to act or not act in particular ways, two general guidelines appear to be useful: the least intrusive and minimally aversive (LIMA) principle and the dead-dog rule. The LIMA principle addresses the excesses and abuses that might arise when aversive or intrusive dog-training procedures are implemented. As such, it applies to both positive and negative punishment, and covers procedures that generate states of emotional pain and deprivation (e.g., long-term cold shouldering, crate confinement/isolation, and various restraint techniques). The LIMA principle entails that trainers use the least intrusive and minimally aversive technique likely to succeed in achieving a training objective with minimal risk of producing adverse side effects. Essentially, the LIMA principle is a competency criterion, since only competent trainers possessing the necessary know-how can make the required assessments and have the skills needed to ensure that the least intrusive and aversive procedure is in fact used. To speak of the effective and humane use of dog-training procedures in the absence of competency criterion borders on the ridiculous. Accordingly, incompetent uses of attractive and aversive motivational stimuli to modify dog behavior are liable to produce harmful effects that violate the dog's interests and breech the trust of the responsible dog owners seeking help.

A second general guideline that promotes the effective use of training procedures is the dead-dog rule, which recommends that training criteria and objectives be defined in terms that a dead dog cannot satisfy (see *Dead-dog Rule* in Volume 2, Chapter 2). In essence, the dead-dog rule is a complementary logic for framing the LIMA principle. By converting training goals into affirmative statements and identifying objectives that can be achieved only by a live dog, the resultant perspective is biased toward reward-based training efforts. For example, instead of training a dog not to bite (dead dogs do not bite), the dog is trained to be friendly and trusting, that is, to show affectionate, cooperative, and playful behavior incompatible with aggression—behavior that a dead dog cannot do. In the case of aversive motivational stimuli used in the context of aversive inhibitory control, the training objective is best described in terms of positive behavioral change that places the primary emphasis on escape-avoidance adjustments and the establishment of a *training space*, based on the acquisition of predictive information and a socially acceptable *escape-to-safety* response that result in reward. When properly performed, all training is reward based insofar as the dog learns how to control attractive and aversive events while negotiating conflict. In the context of reward-based

training, the dead-dog rule and the LIMA principle provide general guidelines for the use of attractive and aversive motivational stimuli to modify dog behavior (see *Compliance* in Volume 2, Chapter 2). When aversive procedures are used, the trainer should possess an objective rationale and the skills necessary to implement the procedures safely and effectively. The suppression of behavior by means of inhibitory procedures is appropriate and useful when regulating behavior governed by an excitatory imbalance and impulsivity but only to the extent that it is performed in the context of coordinated reward-based activities aimed at filling the void.

Cynopraxic trainers acknowledge and respect the dog's preference for pleasure by advocating the use of procedures that utilize reward and minimize punishment. However, to train a dog to a reasonable degree of reliability, the use of both attractive and aversive motivational incentives is an inescapable fact of life. In an important sense, reward and punishment are not properties of motivational stimuli or evoked attractive or aversive states but rather flow from the dog's ability to produce outcomes that either meet or exceed prediction-control expectancies. Training is not about making dogs feel good or bad—rather it is about enabling them to adapt well.

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Appendix A

Sit-Stay Program

Modified Sit-Stay Instructions

Sit-stay training fosters competent skills for obtaining reward and avoiding its loss by training the dog to defer, wait, and relax in the process of seeking rewards. Sit-stay training is integrated with play, providing an additional source of reward and balance. In addition to affectionate petting and attention, sit-stay behavior is reinforced with food rewards of variable size, type, and frequency. The schedule and duration of stay periods also has a potentially rewarding effect on stay behavior. That is, once a standard expectancy is established, comparatively short stay periods may be conducive to reward via surprise. On the other hand, longer-than-usual stay periods may produce punitive effects that are inimical to sit-stay objectives. As a result, stay periods should only be gradually increased in duration and arranged to occur so that longer ones are followed by a series of shorter ones, play, or other sources of positive surprise (e.g., better-than-usual food rewards). Stay-training sessions are generally begun with short-stay periods, followed by a mix of variable duration periods in between, and finished with a long-stay period at the end. Each session is introduced and concluded with a period of play.

The initial lesson consists of training the dog to come to a closed hand after retrieving a ball or simply coming in the case of dogs showing little interest in ball play (see *Introductory Lessons* in Chapter 1). Just before the hand is opened, the bridge signal "Good" is spoken in a playful tone. The ball is taken and tossed for the dog to retrieve. Dogs that are uninterested in fetching a ball are permitted to explore the training situation freely between trials. Additional trials are initiated by calling the dog's name and making a smooch or squeaker sound after the dog picks up the ball, thus evoking an orienting response. As the dog turns in the direction of the trainer, the trainer can deliver a click and then flick the right hand to the side. The vocal signal "Come" is spoken in a friendly and encouraging way, followed by the voice bridge "Good" and the delivery of the reward concealed in the right hand. After each exercise, the dog is encouraged to retrieve a ball or move away with the release signal "OK" and a clap or two.

Improved orienting behavior can be achieved by putting a squeaker bulb in the right hand (held by the last two fingers), and squeezing it just as the dog approaches the hand. The bridge "Good" is spoken just before the hand is opened. In addition, an odor (orange or orange-lemon mix) can be placed in the squeaker, thereby establishing a linkage between the odor, squeaker sound, and food. As the result of repeated associations between the squeaker and food, the squeak sound acquires an enhanced potential for evoking an orienting response. Bridging the occurrence of the orienting response with a click and treat can further improve attention control. Olfactory conditioning is included in sit-stay training in cases where a platform for counterconditioning and desensitization is being prepared (see *Systematic Desensitization* in Chapter 3 and *Olfactory Conditioning* in Chapter 6).

With the dog coming rapidly to the closed hand, the trainer encourages the dog to sit by moving a hand up and behind the dog's head, causing it to follow and sit. The sit response is

reinforced with the bridge "Good," which is timed to coincide with the earliest movement in the direction of sitting. The sit response should be well trained to a hand signal before a "Sit" signal is added as a cue or command. The easiest way for most dogs to learn how to sit on command is to pair the "Sit" signal with a hand signal. The vocal signal is only paired with the hand signal after the dog is sitting consistently in response to the hand movement. If the dog fails to sit in response to the vocal cue, the hand signal is used to prompt the response. The trainer should avoid repeating the "Sit" command, but instead should use the hand to lure the dog into position, if necessary. The dog should gradually learn to sit equally well to both vocal or hand signals, but normally the signals are presented together. Although physical prompting, fading, and shadowing procedures are ordinarily used to increase reliable stimulus control over sit-stay behavior, these techniques are generally avoided with the goal of training the dog to defer without resorting to force of any kind.

Each successful sit response is rewarded, and additional rewards are given to the dog after varying durations of waiting in the sit position. The duration component of stay training is accomplished in the context of shaping an attending response. With the dog sitting in front, the trainer makes a smooch or cluck-click sound to encourage the dog to look up at the trainer and then to make eye contact before saying "Good" or clicking and delivering a food reward and affectionate pet. During such training, the trainer should make a friendly face expressing pleasure at the dog's effort and keep the training session upbeat and fun spirited. Initially, the bridge is timed to occur immediately as the dog looks up, but gradually requires that the dog hold eye contact for 1 or 2 seconds. As the dog learns to look up into the trainer's eyes, its name is presented just in advance of the smooch or cluck-click sound, a prompt that is progressively delayed and gradually faded altogether, but reinstated as needed to capture the dog's wavering attention. After every trial of attention training, the dog is released with "OK" and a clap or two. If the dog breaks the stay position, a brief unrestrained time-out (TO) or rest period of 15 seconds is initiated during which the dog's efforts to obtain food or attention are ignored. The dog is signaled by name to orient, to come, and to sit in accord with a previously mastered criterion that the dog is likely to perform successfully, even going back to conditioning the bridge signal, if necessary.

Distance is gradually introduced after a high degree of reliability is established over the duration element with the dog both in front and on the left side. With the dog looking up, the trainer presents the right hand, palm toward dog, and vocally praises the dog as it continues to stay in place, followed by a food reward and release. The vocal signal "Stay" is subsequently paired with the hand signal as the trainer takes a 1-foot step back, bridges the stay response, and quickly returns to the dog to reward it. This process is repeated a number of times with variable durations without releasing the dog. The dog is trained to expect additional rewards to follow rather then learning to get up in anticipation of being released. If the dog breaks without being released, a 15-second TO-rest period is initiated. Reliable stay at increasing durations and distances is achieved over several sessions. If at any point in the process the behavior breaks down, the trainer should go back to a previously successful step and continue from there. The duration of sit-stay sessions varies according to the dog's needs and motivation, but should be periodically interrupted with ball play or other play activities. Stay training can be repeated several times during the day in different locations around the house. Once a high degree of reliability is established over duration and distance control, an element of increasing difficulty and distraction can be added in accordance with sit-stay program criteria (see *Stay Training* in Chapter 1).

Dogs that repeatedly break the stay position may benefit from response blocking (e.g., active-control line) and vocal prompts ("Eh, eh"); however, stern reprimands, directive prompts, or forceful handling should be avoided. The goal is to train the dog to sit and stay to obtain attractive rewards and

avoid their loss. When gentle vocal prompting is used, it should be applied to the earliest intentional movements rather than applied after a dog breaks. An active-control line can be effectively used to help prevent unnecessary errors by training a dog to first stand-stay and then returning to sit-stay training. If a dog breaks completely, a brief TO-rest period follows during which the dog is ignored. If the dog barks during sit-stay training, the barking response should be brought under stimulus control. Jumping up should be treated in a similar way (see instructions for bring barking and jumping up under stimulus control in *Hyperactivity and Social Excesses* in Chapter 5). Once under adequate stimulus control, the opportunity to bark or jump up can be used as a reward. In the case of highly disruptive behavior, the trainer can leave the training room with the dog left on the other side of the door with the leash pinched in the doorjamb. The time-out lasts for 30 seconds provided that the dog has not scratched or barked for at least 10 seconds.

Once the sit-stay is mastered, a similar pattern of control is established involving down-stay training. Whereas the sit-stay is practiced with the dog in front and at the left side, the down-stay is practiced exclusively with the dog at the left side. In addition to luring and shaping techniques as described in Chapter 1, the down module can be trained by using an attention-cuing procedure. In this case, the trainer establishes eye contact and then glances at a point just in front of the dog. A constant gaze is fixed on the spot as the trainer steadily points and then taps over it. If the dog fails to lie down, the trainer looks at the dog, establishes brief eye contact, and then glances back at the spot and repeats the pointing-tapping procedure. As the dog begins to lie down, the bridge "Good" is delivered, followed by a treat after the action is completed. Many dogs resistant to lying down by other methods are often surprisingly responsive to this technique. Alternatively, a small square of cotton adhesive tape or Band-Aid is scented and presented to the dog to sniff and paired with food several times. The scented Band-Aid is then taped to the floor. The same attention-cuing procedure as described previously is used to train the dog to orient and sniff the scented tape and then to lie down. The scented tape can be gradually placed at greater distances from the dog. Again, the trainer makes eye contact with the dog, breaks it off to glance toward the scented tape, and then points at the spot. The dog is encouraged to go to the spot and sniff (click), wait there or lie down in response to a pointing-tapping action ("Good" and reward), and required to stay until it is released ("OK" and clap). In one variation, the pointing-down signal is gradually faded, and the dog learns to lie down in response to the scented tape alone. The scented tape can be affixed to a variety of objects that are left in plain view or hidden for the dog to find, perhaps becoming the basis of an interesting game for dogs possessing a proclivity for such activity. Procedural variations based on the spotting technique can be used in a variety of training applications requiring a precise search and down-stay component.

The various daily sit-stay skills listed in Figure A.1 represent a guide, not a rigid program. Instead of practicing all of the tasks listed for a particular day, trainers should limit practice activities to as many items as the dog can successfully learn and perform without becoming overly stressed. The goal of sit-stay training is to establish control while encouraging a set of positive secondary emotional associations with the training process, in particular imbuing the act of sitting and staying with feelings of to enhanced comfort, safety, and relaxation. In addition to benefits for dogs, reward-based sit-stay training can be helpful to owners by introducing the rudiments of training and opening up a new perspective on behavioral change and control. By avoiding coercive techniques, family members are obliged to learn more positive strategies and ways to affirmatively frame the dog's behavior (e.g., the dead-dog rule) and to use reward more effectively. While training the dog to sit and stay, a new level of appreciation for the dog's abilities and needs may be engendered. Finally, as the result of using a reward-based method, even briefly, owners may learn to think more clearly and rationally about the process of mediating behavioral

Dog's Name: Date:

SIT-STAY TASKS

PRELIMINARY SIT TRAINING	DIFFICULTY RANK 1–5	NO. TIMES REPEATED
The dog sits for a food reward		
The dog sits quietly for 5 seconds		
The dog sits quietly for 10 seconds		
The dog sits quietly for 15 seconds		
Day 1: The dog should		
Sit		
Sit for 5 seconds		
Sit for 5 seconds		
Sit for 10 seconds		
Sit for 5 seconds		
Sit for 10 seconds		
Sit while you take 1 step backward and forward		
Sit while you take 1 step sideways, to the right, and return		
Sit while you take 1 step sideways, 1 step to the left, and return		
Sit while you step back 3 steps and return		
Sit while you take 3 steps to the left and return		
Sit while you take 3 steps to the right and return		
Sit for 10 seconds		
Day 2: The dog should		
Sit		
Sit for 5 seconds		
Sit for 5 seconds		
Sit for 10 seconds		
Sit while you step back 3 steps and return		
Sit while you take 3 steps to the right and return		
Sit while you take 3 steps to the left and return		
Sit for 10 seconds		
Sit while you walk halfway around the dog		
Sit while you walk halfway around the dog in the opposite direction		
Sit while you take 5 steps back and return		
Sit while you walk around the dog		
Sit while you take 5 steps to the right and return		
Sit for 10 seconds		
Sit while you take 5 steps to the left and return		
Sit while you take 10 steps back and return		
Sit for 20 seconds		
Sit while you take 10 steps to the right and return		
Day 3: The dog should		
Sit for 5 seconds		

FIG. A.1. Sit-stay program. Modified from a client handout with permission by Victoria L. Voith (1979).

Sit for 10 seconds		
Sit for 20 seconds		
Sit for 10 seconds		
Sit while you walk halfway around the dog and return		
Sit while you take 5 steps back and return		
Sit for 5 seconds		
Sit while you walk halfway around the dog and return		
Sit while you take 10 steps backward and return		
Sit while you take 5 steps to the left and return		
Sit while you take 5 steps to the right and return		
Sit while you walk completely around the dog		
Sit while you run back 10 steps and return		
Sit while you take 10 steps to the right, walk briskly to an equidistance to the left, and return		
Sit while you do the above in the opposite direction		
Sit for 10 seconds		
Day 4: The dog should		
Sit for 5 seconds		
Sit while you walk around the dog		
Sit for 20 seconds		
Sit while you take 20 steps backward and return		
Sit for 20 seconds		
Sit while you take 10 steps briskly backward and then toward the dog		
Sit while you take 10 steps to the right, walk an equidistance to the dog's left, and return		
Sit while you do the above in the opposite direction		
Sit while you walk briskly around the dog twice		
Sit while you slowly walk out of the room and immediately return		
Sit while you leave the room for 5 seconds		
Sit while you walk around the dog 3 times		
Sit while you run 10 steps to the left of the dog and walk briskly back		
Sit for 30 seconds		
Sit while you leave the room for 5 seconds		
Sit while you leave the room for 10 seconds		
Sit for 10 seconds		
Day 5: The dog should		
Sit for 10 seconds		
Sit for 15 seconds		
Sit for 20 seconds		
Sit for 10 seconds		
Sit for 20 seconds		
Sit while you walk around the dog		
Sit while you briskly walk around the dog twice		
Sit while you walk back 10 steps briskly and return		
Sit while you run to the left 10 steps and return		
Sit while you run 10 steps to the right and return		

Sit for 20 seconds		
Sit for 5 seconds		
Sit while you walk around the dog		
Sit while you leave the room for 5 seconds and return		
Sit while you leave the room for 10 seconds and return		
Sit while you leave room for 5 seconds and then return and walk around the dog before rewarding the dog		
Sit while you walk around the dog twice		
Sit while you leave room for 10 seconds and, on returning, walk around the dog before rewarding the dog		
Sit for 20 seconds		
Sit for 5 seconds		
Day 6: The dog should		
Sit for 10 seconds		
Sit for 15 seconds		
Sit for 20 seconds		
Sit while you walk around the dog		
Sit while you run 10 feet to the left and return		
Sit while you run 10 feet to the right and return		
Sit for 20 seconds		
Sit while you leave the room for 10 seconds		
Sit while you leave the room for 20 seconds		
Sit while you walk around the dog		
Sit while you leave the room for 10 seconds and walk around dog when you return		
Sit while you leave the room for 15 seconds and circle the dog when you return		
Sit for 5 seconds		
Sit while you circle the dog twice		
Sit while you walk 15 feet to the left, run 15 feet past the dog to the right, and walk back		
Sit and repeat the above		
Sit while you do the above in the opposite direction		
Sit for 5 seconds		
Day 7: The dog should		
Sit for 5 seconds		
Sit for 10 seconds		
Sit for 5 seconds		
Sit while you step back from the dog, sit down, and return		
Sit while you step back 5 feet from dog, sit down for 5 seconds, and return		
Sit while you walk across the room, sit (on a chair) for 15 seconds, and return		
Sit for 5 seconds		
Sit while you walk briskly 20 feet to the right away from the dog and return		
Repeat the above to the left		
Sit for 5 seconds		
Sit for 30 seconds		
Sit while you walk around the dog twice		
Sit while you take 10 steps briskly backward and then toward		

the dog		
Sit for 10 seconds turned away from the dog		
Sit for 20 seconds		
Day 8: The dog should		
Sit for 5 seconds		
Sit for 10 seconds		
Sit for 20 seconds		
Sit while you leave the room for 10 seconds		
Sit while you leave the room for 15 seconds		
Sit for 5 seconds		
Sit for 30 seconds		
Sit for 10 seconds		
Sit while you run 15 feet to the left and then to the right and back		
Sit while you do the above in the opposite direction		
Sit for 10 seconds		
Sit while you walk 10 feet away, circle the dog, and walk back		
Sit while you repeat the above at a brisk walk		
Sit while you circle the dog at 10 feet at a brisk walk		
Sit while you circle the dog at a brisk walk twice		
Sit for 10 seconds		
Sit while you leave the room for 10 seconds		
Sit for 5 seconds		
Sit while you circle the dog at 10 feet away		
Sit for 30 seconds at 5 feet away		
Sit for 10 seconds while 5 feet behind the dog		
Day 9: The dog should		
Sit for 10 seconds		
Sit for 60 seconds		
Sit for 10 seconds		
Sit while you circle the dog		
Sit while you leave the room for 10 seconds		
Sit while you back up 10 feet, sit down for 15 seconds, and return		
Sit while you circle the dog at 10 feet at a run		
Sit while you circle the dog twice at a run		
Sit while you reach for your toes		
Sit while you touch your toes twice		
Sit while you walk 15 feet to the right and then left before returning		
Sit while you do above in the opposite direction		
Sit for 10 seconds		
Sit for 30 seconds while you sit 5–10 feet away		
Day 10: The dog should		
Sit for 5 seconds		
Sit while you back up 10 feet and circle the dog at a brisk walk		
Sit while you walk to a chair and sit down for 10 seconds		
Sit while you walk to a chair sit down for 20 seconds and return		
Sit while you walk 20 feet to the right and run past the dog to		

20 feet to the dog's left and walk back		
Sit while you do above in opposite direction		
Sit for 10 seconds and both of you sit for 60 seconds		
Sit while you walk to a chair, sit for 10 seconds, walk briskly to 10 feet past the dog, and return slowly		
Sit while you repeat above		
Sit while you repeat above at a jog		
Sit while you repeat above at a fast jog		
Sit for 10 seconds		
Observations:		

change, thereby becoming less reliant on punishment and adopting a more constructive and balanced approach to their dog's training. As control over the sit-stay module is established, family members can be encouraged to integrate it into everyday activities possessing reward value for the dog.

Encouraging owners to keep a journal and other records associated with sit-stay training can help them to become more aware and objective with respect to their dog's behavior—changes of viewpoint that are particularly important in cases involving serious adjustment problems. The dog's response to sit-stay training and daily progress should be tracked by keeping a record of daily training activities. The relative difficulty of each sit-stay requirement is estimated by the owner in terms of a five-point scale between 1 (easy: almost without error) through 5 (difficult: dog made many mistakes). The owner should jot down each day of exercises on a separate sheet of paper, giving space for notes and detailed observations about the dog's response to sit-stay training. Later, the estimated relative difficulty is recorded on the master sheet, along with a letter grade (+A-, +B-, +C-) based on overall working attitude and the number of times that the response had to be repeated to reach criteria. In addition to estimating the difficulty for the dog and performance grading, the time of day, situational variables (e.g., distractions), motivational state (e.g., before or after meals), adverse influences, positive secondary changes, and so forth should be noted. Owners should be encouraged to write down their concerns and successes, thereby helping them to think more clearly about the dog's response to training projects.

Note: The foregoing instructions are in large measure consistent with Voith's intent and include some specific items that she included in her original instruction sheets (Voith, 1979); however, the procedures deviate in several significant ways from her original instructions.

SIT-STAY SKILLS

See Figure A.1.

REFERENCE

Voith VL (1979). Sit-Stay Program. Modified from a client handout with permission by Victoria L. Voith.

Appendix B

Sit, Down, Stand, and Stay Practice Variations

Dog's Name: Date:

SIT VARIATIONS

Exercises Session	1	2	3
Sit with hand signal only			
Sit with voice signal only			
Sit from stand position after 3-second stay			
Sit from down position after 5-second stay			
Quick-sit while controlled walking			
Sit after starting exercise and 10-second stay			
Sit with the trainer in front after making and holding eye contact for 2 seconds			
Sit after the dog moves from the trainer's left side to the front			
Sit with the trainer behind the dog after 3-second stay			
Sit with the dog to the right after 10 seconds			
Sit with the trainer crouching			
Sit with the trainer sitting on the ground			
Sit with the trainer lying on the ground			
Sit while the trainer walks by at 3 feet away			
Sit while the trainer walks 5 feet away			
Sit from a stand at a distance of 3 feet			
Sit from stand after interrupted auto sit			
Sit from down position at a distance 5 feet			
Sit from a separate room			
Sit while another dog walks by			
Sit before a ball is tossed			
Sit at 10 feet away before a ball is tossed			
Stay and sit after a ball is tossed; dog is then released to chase the ball			
Sit after the dog turns around and stays 5 seconds			
Sit after moving to the right			
Sit after moving to the left			
Sit before jumping through a hoop or over a hurdle			
Quick-sit in the presence of a strong distraction (e.g., a squirrel)			
Quick-sit before a ball is tossed			

Observations:

Dog's Name: Date:

DOWN VARIATIONS

Exercises Session	1	2	3
Down from sit with hand signal only			
Down from sit voice signal only			
Down from starting position after 5-second stay			
Down from the stand after 10-second stay			
Down from sit in front after 15-second stay			
Down from sit with the trainer to the left			
Down from sit with the trainer behind			
Down from sit with the trainer turned away			
Down from sit with the trainer crouching			
Down from sit with the trainer sitting on the ground after 10-second stay			
Down from sit with the trainer lying on the ground after 5-second stay			
Down from stand with the dog in front			
Down from stand with the dog to the right			
Down from stand with trainer behind the dog			
Instant-down			
Down from sit at a distance of 3 feet			
Down from sit from a separate room			
Down from sit at a distance 5 feet after 15-second stay			
Down from sit as another dog walks by			
Down from stand while another dog walks by			
Down from sit before the dog is released to chase a ball			
Down from sit after a ball is tossed; the dog is then released to chase the ball			
Down at 10 feet away before a ball is tossed			
Down after turning around			
Down on recall			
Down from sit after moving to the left			
Down after jumping through a hoop or over a hurdle			
Down from sit while near traffic			
Instant-down while running along side the trainer			

Observations:

Dog's Name: Date:

STAND VARIATIONS

Exercises	Session 1	2	3
Stand with one step forward			
Stand with voice signal only			
Stand from the starting position after 5 seconds			
Stand from the down after 30 seconds			
Stand from sit with the dog in front after 10 seconds			
Stand from down after 45-second stay			
Stand from sit with the trainer behind the dog			
Stand from sit with the trainer turned away			
Stand from down with the trainer crouching			
Stand from sit with the trainer sitting on the ground			
Stand from sit with the trainer lying on the ground			
Stand from down with the trainer in front			
Stand from down with the trainer to the left			
Stand from down with the trainer behind			
Stand after instant-down			
Stand from down at a 5 feet away			
Stand from down as another dog walks by			
Stand from sit at a distance 5 feet near a busy corner			
Stand from down with hand signal at a distance of 10 feet after 30-second second stay			
Stand from sit while another dog walks by			
Stand from down at 5 feet away before the dog is released to chase a ball			
Stand from sit after a ball is tossed; the dog is then released to chase the ball			
Stand from down at 15 feet away before tossing a ball			
Stand and stay after turning around			
Stand from down after drop on recall			
Stand from sit after moving to the left			
Stand after quick-sit and 10-second stay			
Stand after instant-down and 30-second stay			
Walking stand-stay while alongside the trainer			

Observations:

Dog's Name : Date:

SIT, DOWN, AND STAND COMBINATIONS

Exercises	Session 1	2	3
Stand and stay for 10 seconds			
Sit from stand with voice and hand signal			
Down from sit after 5-second stay			
Sit from down after 5-second stay			
Stand from sit after 5-second stay			
Stand stay for 10 seconds 5 feet away			
Sit-stay for 20 seconds 5 feet away			
Down-stay for 30 seconds 5 feet away			
Walking stand-stay and then facing the dog at 5 feet away for 10 seconds			
Sit from stand at 5 feet away			
Down from sit at 5 feet away			
Sit from down at 5 feet away			
Stand from sit at 5 feet away			
Starting exercise with auto sit from the left side			
Starting exercise with stand interruption			
Starting exercise to heeling w/o auto sit			
Starting exercise, auto sit, and stay for 30 seconds for recall, front sit, and finish to the left side			
Walking stand-stay to starting position and auto sit after 10-second stay			
Starting exercise to auto sit, sit-stay, and 10-second stay before down and sit from down at a distance 15 feet			
Sit-stay for 30 seconds at 20 feet to recall, sit-front, and finish to right side			
Starting exercise to auto sit, down, and stay for 1 minute at 15 feet away before returning and dog is released to fetch a ball			
Sit, down from sit, stand from sit, and stay for 20 seconds at 15 feet away			
Down from stand at 20 feet, followed by stand from down after 1-minute stay			
Walking stand-stay, sit, and down from 10 feet followed by 30 seconds			
Drop on recall, sit from down, and stand			
30-second stand-stay followed by ball play			
1-minute sit-stay followed by ball play			
5-minute down-stay followed by recall and finish from 20 feet away			

Observations:

FIG. B.1. Practice variations: sit, down, and stand. These tasks are intended as a general guideline. They should be gradually mastered and practiced in progressively longer and more difficult sequences. Many of the tasks depend on a well-established stay response that has been made reliable by sit and down-stay training. Tasks practiced are checked off after every daily session.

GOOD CONDITIONING	ATTENTION ORIENTING	COME SIT/FRONT	SIT AND STAY	DOWN AND STAY	STAND/SIT/DOWN CYCLE	COME SIT/FRONT FINISH	STARTING EXERCISE	CONTROLLED WALKING	QUICK/SIT	BALL PLAY
1										
2										
3										

Observations:

FIG. B.2. Basic training practice checklist.

Appendix C

Posture-facilitated Relaxation (PFR) Training

Basic Guidelines and PFR Techniques

PFR training can be beneficial for puppies and dogs exhibiting a variety of adjustment problems. Of course, special precautions must be taken in the case of potentially aggressive dogs. Before being exposed to PFR training, such dogs should receive appropriate attention and integrated compliance training, and preliminary graduated counterconditioning as needed to reduce excessive reactivity to touching and handling. Adult dogs should be cautiously introduced to the procedure and may require a muzzle if they show signs of aggressive reactivity. The trainer should always be aware of the potential risks involved and error on the side of safety when performing such procedures, especially in the case of physically powerful dogs with a history of aggressive behavior.

Environmental Considerations

1. PFR training is first introduced in familiar situations with few distractions, but as a dog's relaxation response improves, it can be performed under more distracting and potentially stressful conditions. In the case of dogs exhibiting separation-related problems, massage should be performed in the room where the dog is left alone.

2. PFR training should be performed at times of need for de-arousal and increased relaxation.

3. A blanket or rug can be spread out for the dog to lie down on during PFR training. The rug gradually acquires a calming effect by way of association with PFR training. The dog can be trained to go to the rug and stay there at times of increased arousal associated with social excesses. Finally, the rug can be used to generalize the effects of relaxation and desensitization from the massage situation to other places. Conditioned comfort rugs can play a useful role in various fear-reduction procedures (Hothersall and Tuber, 1979).

PFR Techniques

1. PFR training progresses through graded postures ranked in terms of relative relinquishment of control and postural potential for inducing relaxation. The stepwise resistance (muscular tensing) and letting go in response to physical prompting and blocking is an intrinsic part of the PFR training process (see *Posture-facilitated Relaxation* in Chapter 6), without which a rapid and deep relaxation response is not achieved.

- PFR training begins with a collar control, reassuring eye contact, and a soft smile (friendly face), followed by a series of physical prompts causing the dog to stand, sit, lie down, and roll over onto its side. In addition to being the most control-relinquishing posture, the recumbent posture is the one most conducive to the

induction of a deep relaxation response (Figure C.1).

- If the dog becomes overly aroused or resistant, the massage is limited to actions and postures that it tolerates best and then additional steps are gradually added as its ability to relax and cooperate improves.
- Transitions triggering resistance can be worked through by repeating the same prompt and control with vocal reassurance ("Relax") and additional massage, until the dog shows signs of increasing acceptance and relaxation.

2. Each posture is physically prompted and maintained with vocal prompting "Relax." Otherwise, talking to the dog is minimized, except as needed to provide occasional reassurance and comfort.

3. The dog is paced through the massage sequence according to its response to each step. With practice, the speed of induction improves, especially with the aid of an olfactory-signature stimulus. Some puppies and dogs appear to be more responsive to a rapid sequencing of postural shifts and faster massage activity, whereas others require slower steps and more sustained massage.

4. The best results are achieved by matching handling and massage activities to the dog's temperament and needs. Some dogs prefer firm handling and massage, whereas others require more sensitive and gentle handling and massage. Oppositional behavior should be managed patiently but firmly, constantly guiding the dog back to the posture and position required. Going back to a previously successful step in the PFR cycle can be helpful, thereby increasing the relaxation response before trying to move ahead again.

- Physical assertions of control and TO, though sometimes necessary and expedient, are always reserved for those situations where affectionate persuasion has failed and where alternative courses of action are judged inappropriate.
- PFR training may challenge the dog and momentarily raise competitive tensions, but it should never be deliberately provocative or adversarial or degrade into manhandling. Competitive tensions are gradually resolved via the counterconditioning effects of increasing relaxation and trust.

5. Each massage stroke should be performed with the intention of intensifying the relaxation response. Absentminded rubbing does not produce the same benefit as focused massage.

6. The rhythm of massage should be slow and steady, with the time spent on each stroke, and the interval between strokes kept approximately the same. As the dog's response to PFR training improves, the massage stroke can be varied as needed to intensify the relaxation effect.

7. PFR training should be performed with a high degree of order, consistency, and precision from session to session. Predictable massage actions, controls, and manipulations gradually promote a dog's feelings of enhanced comfort, safety, and relaxation (security).

8. During the massage, the trainer should focus on breathing and project from the belly to the hands a feeling of comfort and care.

9. After several massages in which a progressively enhanced relaxation response is achieved, an olfactory signature is introduced in the context of thermal touch and the induction of a deep relaxation response. Gradually, the olfactory signature is presented at progressively earlier points in the PFR sequence. Eventually, the scent is presented just before the PFR cycle is initiated, thereby forming a conditioned association with the initiation and induction of relaxation. When fully conditioned, the odor should help to facilitate the PFR-training process, as well as improve the dog's responsiveness to various behavior-therapy procedures. The conditioned odor appears to enhance the dog's receptivity to counterconditioning efforts by directly helping to restrain aversive arousal or by altering the dog's appraisal of stimulation occurring in the presence of the odor.

10. A record of the dog's response to various prompts and controls should be kept to track its progress. In addition to general impressions regarding the dog's relative resistance or compliance at various stages of the PFR cycle, ranked on a point scale from 1 (resists: struggles constantly) to 5 (compliant: fully cooperative), heart rate should be recorded. A resting heart rate should be measured before PFR training is initiated, recorded after the dog is prompted to stand, and meas-

Dog's Name: Date:

Session No.:

PFR TRAINING CHART

	PROMPT / CONTROL	STRUGGLE / RESISTANCE	COMPLIANCE/ COOPERATION	HEART RATE	COMMENTS
1	Collar				
2	Stand				
3	Sit				
4	Down				
5	Lateral				
6	Olfactory Signature				
7	Petting				

FIG. C.1. PFR techniques.

ured immediately after the petting period at the conclusion of the PFR cycle, either by counting beats with fingers pressed over the femoral artery for 15 seconds or by using an inexpensive radiotelemetry device (see *Devices Used to Monitor Autonomic and Stress-related Changes* in Chapter 9). Changes in heart rate provide an objective measure of change occurring as the result of PFR training over time.

PFR Training Instructions

Collar Control

The collar control is secured by grasping the collar at approximately at 4 and 8 o'clock. While holding the dog's head securely, the jaw muscles are rhythmically massaged with the thumbs moving in a circular direction, while the trainer maintains affectionate eye contact, saying "Relax" in a reassuring tone.

Stand Prompt and Control

Next, the collar is grasped by the right hand at about 9 o'clock while the left forearm goes under the dog's belly bringing it up and around to the front. The trainer is aligned perpendicularly with the dog forming a T shape—an ethologically significant orientation (Fox, 1971). As the dog is steadied in the

standing position, the left hand moves to the back of the neck where a rhythmic massage is applied to the neck, withers, and shoulders. The pressure of the massage stroke varies according to the dog's response to the stimulation. Some dogs and puppies may find such handling provocative and may attempt to wiggle out of the position, movement that should be prevented by placing the left forearm under the belly and shifting the puppy back into proper alignment.

It is important to maintain the massage for at least 30 seconds. If the dog struggles or attempts to sit, the action is prevented, and the dog is prompted back into the stand position. As the dog settles, its heart rate should be measured at the femoral artery by counting the number of beats that occur during a 15-second period.

Sit Prompt and Control

Once the dog accepts the stand control and massage, the left hand moves slowly and rhythmically down the spine until reaching the hip bone. The massage stroke along the spine is performed with a slow inchworm action. The hand is then opened across the breadth of the hip. With the thumb and first two fingers placed into the slight depression just anterior to the iliac crest, a gentle pincer pressure is applied until the dog sits. As the dog sits, the trainer says "Relax" and extends the massage to include the shoulder and lumbar muscles. When the sit posture is prompted, some dogs and puppies may resist and attempt to escape by shifting out of position or turning and mouthing on the hand. If such struggling does occur, it should be discouraged and the puppy prompted to complete the action, perhaps by pushing forward from behind the stifle. Pushing down on the rump should be avoided. Although assertive control and prompting are sometimes necessary, especially during the first or second cycle of PFR training, it is far better to achieve each postural transition without evoking excessive opposition.

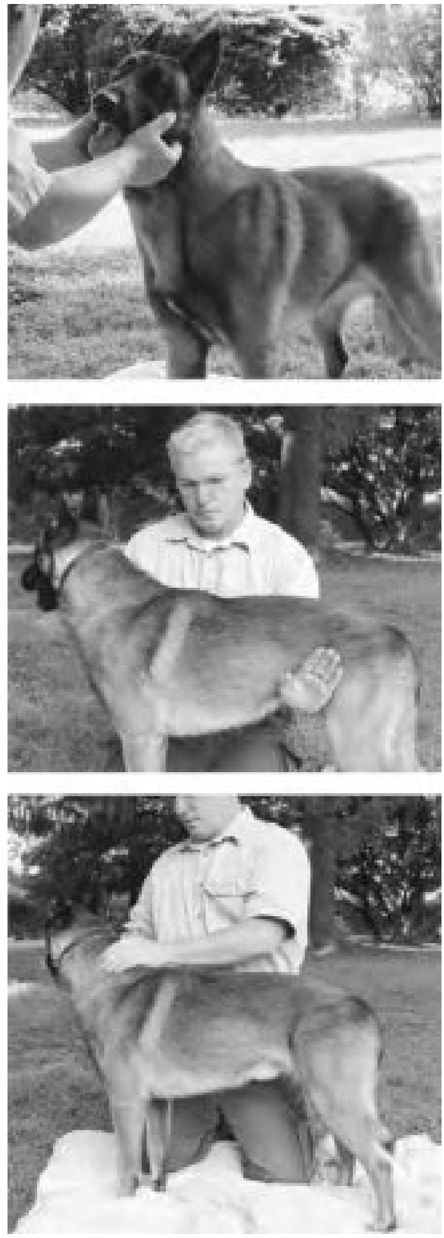

FIG. C.2.a. Stand prompt and control.

Down Prompt and Control

The left hand grasps the collar from behind the neck at a point slightly left to the midline with the left forearm laid along the dog's back. A steady downward pressure is applied as the right leg is grasped at the elbow and pulled forward as the dog is lowered down. When prompted into the down position, the dog's back should lean toward the handler. Once the dog settles into the down position, massage is applied over muscled areas of the shoulders, hips, and upper legs. The fingers of

FIG. C.2.b. Sit prompt and control.

FIG. C.2.c. Down prompt and control.

the massage hand should be closed together and slightly cupped. The best all-purpose massage stroke is achieved by moving the fingers in a circular or spiraling movement over muscled areas. Carefully following and participating in the developing relaxation response help to guide the massage process intuitively. The trainer should focus on breathing in a rhythmic manner and actively feel the relaxing effects of the massage develop. When performed properly, massage benefits both the trainer and the dog.

Again, despite the most gentle and patient handling, some reactive puppies and dogs may respond aggressively to such manual control, perhaps necessitating more secure

restraint (muzzling) or other emergency control measures (e.g., time-out). Limiting postural shifts to the stand and sit may be necessary in the beginning, at least until the dog learns to accept the massage and starts to relax, whereupon the down control can be attempted again.

FIG. C.2.d. Lateral prompt and control.

Lateral Prompt and Control

Once the dog accepts and relaxes in the down position, it is rolled over onto its side. This maneuver is accomplished by placing the left hand on the lumbar muscle just in front of the hip. After pushing the dog's elbow under its body, the right hand is placed (knuckles up) over the neck so that the little finger is situated just behind the base of the jaw, whereupon the dog is rolled over onto its side. As the dog accepts the lateral control, the fingertips of the right hand are placed on the temporal muscle just in front of the ear while the fingertips of the left hand are placed on the masseter. A rhythmic massage is carried out with the fingers moving circularly in opposite directions. In addition to observing the dog's rate of breathing, the commissure of the eyelid should be monitored as an indicator of building relaxation. As the dog relaxes, the frequency of blinking decreases as the eye begins to close and finally shuts.

Ear, Jaw, and Lateral Massage

As the relaxation response deepens, the ear is taken by the thumb and index finger of the right hand and massaged. The thumb is then inserted gently into the ear canal and slowly moved outward to the tip of the ear. Most dogs and puppies appear to enjoy this very much and often exhibit a reflexive sigh as the thumb is moved about in the ear canal. This reflexive response, discovered in the context of PFR training and called the auricular relaxation reflex, usually precedes a deepening of the relaxation response. Next, the lower lip is massaged along the length of the jaw with tight spiraling movements. Attention is then turned to the upper shoulder and various muscles and joints of the foreleg. The front paws are carefully manipulated with each digit receiving focused massage. The massage is gradually moved over the rest of dog's body with focused massage applied to the lumbar area and hip, the hindquarters, the various joints, the tail, and the rear paws. In addition to the circular movement previously described, the heel of the hand is used to produce a simultaneous kneading effect, complementing the more focused movements of the

fingertips. Lateral massage is limited to the left side of the dog's body.

Massage on the left side of the body produces a contralateral effect on the right hemisphere of the brain. The right somatosensory cortex plays a prominent role in social and emotional information processing (Adolphs, 2001). In addition, the right medial prefrontal cortex appears to be asymmetrically involved in the cortical integration of emotional and physiological responses to stressful arousal (Sullivan and Gratton, 1998). Massage-induced alterations of activity in the right cortex may promote positive social responsiveness as well as help to modulate emotional and physiological responses to restraint. Whether unilateral massage exerts a benefit via these cortical mechanisms is unknown, but unilateral massage does appear to perform better than bilateral massage for inducing a rapid and deep relaxation response.

FIG. C.2.e. Ear, jaw, and lateral massage.

Thermal Touch

As the relaxation response progresses and reaches a peak (as evidenced by decreased respiration rate, relaxed muscle tone, and lowered or closed eyelid position), the right index finger and forefingers are drawn together and placed on the temporal muscle mass located just in front of the ear. A gentle continuous pressure is applied for 10 to 15 seconds together with a steady care intention is focused on the dog. As a sensation of warmth develops between the fingertips and the point stimulated on the dog's head, the hand is slowly lifted away and centered approximately 2 to 3 inches above the dog's belly. From there, the hands are moved slowly over the dog's body, circulating a sensation of warmth in a manner resembling a slow movement through water.

Olfactory Signature

The last step in the massage is to link an olfactory stimulus or signature with the relaxation response. Normally, the odor of the owner's hand or other family members is presented as the olfactory signature. Alternatively, a dilute (1:30–50) odor (e.g., sandalwood, lavender, or chamomile) is presented during the thermal-touch procedure and the induction of a deep relaxation response. A scant drop of the dilute odor is rubbed into the hands. Alternatively, 2 or 3 drops of the odor

FIG. C.2.f. Thermal touch.

are put on a tissue that is then folded several times into a small square that can be rubbed between the thumb and index finger to draw out the odor. Again, the hands are moved slowly above the dog's body without actually touching, but close enough for the heat and movement of the hands to be felt by the dog

FIG. C.2.g. Olfactory signature.

as a thermal sensation. As the relaxation response deepens, the right hand is cupped gently around the dog's nose, stimulating a sniffing action and surprise. The surprise is of critical importance for forming a rapid and strong association between the state of deep

FIG. C.2.h. Transition petting and release.

relaxation (the physiological expression of acceptance and trust), the odor, and subsequent petting and release. Another method involves placing a small amount of the selected odor on the lips and blowing the scent slowly and unobtrusively over the dog's head from behind, just as an unscented hand is cupped over the dog's nose. The trainer should not blow sharply or directly into the dog's face and should sit upright and behind the dog when performing the procedure. Alternatively, a gentle smooch sound follows the scented breath and is timed to occur just as the unscented hand is placed in front of the dog's nose. The scented-breath technique is based on subtle associative linkages formed between the conditioned odor, surprise, and relaxation. Finally, in some olfactory-conditioning procedures, the odor is delivered from a squeaker bulb by slowly squeezing it and then releasing the slightly depressed bulb to produce a soft squeak.

Transitional Petting and Release

The dog is gradually transitioned out of the relaxation response with firm, long-stroke petting actions that consciously and deliberately follow the lay of coat over the head, neck, back, and chest. As the hindquarters are petted, the dog's heart rate should be measured again and recorded. At the conclusion of the petting phase, the trainer quietly says "OK" and gently claps a couple of times. As the dog stands up, the collar control is applied again with affectionate eye contact and vocal reassurance before the puppy or dog is released for play, training, or another cycle of PFR training. Note the more focused eye contact given by the dog in comparison to response exhibited with the collar control initiating the PFR cycle.

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Appendix D

Puppy Temperament Testing and Evaluation

Temperament Testing

In Volume 2, much was left to the imagination with regard to the procedures used to perform puppy temperament tests (see *Puppy Temperament Testing and Evaluation* in Volume 2, Chapter 2). In addition to describing in detail how the various tests are performed, the potential significance of the information also remains to be discussed. The tests described below borrow from the basic research performed by Scott and Fuller (1965), the testing procedures used by the Bio Sensor Research Team (U.S. Army Super Dog Program), and testing recommendations suggested by Michael Fox (1972). Although temperament tests are not routinely performed, they can be used as an objective tool for evaluating a variety of social, emotional, cognitive, and motivational dimensions in puppies. For applied dog behaviorists needing a highly objective assessment tool for supplementing behavior questionnaires and other instruments (e.g., the Puppy Behavior Profile), such testing may be useful. Temperament tests may also be useful for research purposes, wherein an objective baseline of information is needed. For most practical training purposes, however, the Puppy Behavior Profile, along with interview information and direct observation, provides sufficient information to determine a puppy's training needs.

The Puppy Temperament Test may be most useful in the case of older puppies about whom little information is known. No test, no matter how comprehensive and detailed, can reveal every facet of a puppy's behavior or potential. In addition to specific tests, real-life observations of a puppy's behavior under various circumstances and stressors can be highly revealing and useful. Although an owner can play the role of handler in many of the tests, the administering trainer, especially in cases where special skills may be necessary to control the puppy properly, should perform the role of handler. The tests are designed for puppies from 10 to 20 weeks of age, but can be easily modified for use with younger and older dogs.

Testing Procedures

A. Social Attraction (Passive Handler)

Both the owner and the trainer can alternately play the role of handler. The scorer (owner) holds the puppy on a 6-foot leash as the handler moves to a spot approximately 20 feet

away. After approximately 10 seconds, the handler calls the puppy's name and claps to get its attention and the scorer releases the puppy. If the puppy hesitates, it is encouraged vocally and the handler might crouch down, as well. As the puppy approaches, the handler should once again stand upright. After a brief moment of standing still, the handler should praise the puppy and toss a treat on the ground and pick up the leash. Further information can be obtained by reversing the roles of handler and scorer. Now, the trainer holds the puppy's leash as the owner walks away. The owner repeats the handler procedure in an identical manner. Differences in the puppy's behavior toward the trainer and the owner are noted.

B. Social Attraction (Active Handler)

Holding the end of a 6-foot leash, the handler steps away while calling the puppy's name. If the puppy hesitates, the handler (owner or trainer) calls the puppy's name again and slaps his or her thigh. If necessary, the leash can be dropped as the handler jogs away from the puppy while at the same time encouraging it to follow along with cajoling words and gestures. If the puppy forges into the leash, the handler should run along to keep up.

C. Contact Tolerance

Most puppies enjoy being petted and handled, but some are intolerant of tactile stimulation and may become agitated or overly aroused by taction. For highly reactive or excitable puppies, petting and handling should be limited to minimally provocative stimulation. In addition to petting the puppy's head, body, and tail, the handler should attempt to examine the puppy's mouth, ear's, and feet.

D. Physical Controls

These various controls are typically performed by the trainer, and the owner is later instructed on how to perform them in the context of posture-facilitated relaxation training. Care should be taken not to agitate the puppy unnecessarily. During the performance of each control, the puppy is massaged and reassured. If the puppy becomes highly reactive and fails to calm in response to massage and vocal reassurance, the score for that control is noted and the physical control portion of the test concluded. At the beginning of the test, resting heart rate should be measured, followed by a second measure taken at the end. For specific instructions on prompting the controls, refer to Appendix C, *Posture-facilitated Relaxation (PFR) Training*.

E. Impulse Control (Possessiveness)

For the safety of children and others in the home, it may be helpful to determine the degree of risk that a puppy poses with respect to possessive aggression.

The trainer, taking care not to provoke the puppy unnecessarily, always performs this test with the puppy restrained on a leash. The beef bone or other desirable object used for this test should be tied to a piece of twine, allowing the trainer means to remove it safely from the puppy if the puppy becomes aggressively aroused. The puppy is left with the bone for 1 minute as the handler stands 10 feet away. As the handler approaches the puppy, the leash is picked up to restrain the puppy, if necessary, and the handler reaches toward the bone, just out of the puppy's reach. If the puppy growls or snaps, the attached twine is used to pull the bone away. In the case of a puppy that accepts close contact and petting while it chews on its prize, the trainer can attempt to take away the bone. If there is any doubt about the puppy's intention, the bone is removed by pulling the piece of twine, without applying a muzzle control. If the puppy releases the bone without objection, it is rewarded with a treat offered as trade and the opportunity to have the bone back again. In the case of threatening puppies or puppies appearing stiff with intense possessive interest, testing for bite propensity should be considered. In such cases, a piece of broomstick 1-foot long is covered on one end with an 8-inch square of cloth neatly wrapped around several layers of batting and secured with rubber bands at the base of the wad. The

cloth and batting should be replaced after every use to minimize the presence of confounding odors. Alternatively, fingers of a glove can be filled with cotton balls and shaped into the form an approaching hand. The probe stick is passed under a jacket sleeve, with the padded end or glove protruding out. As the puppy is approached, the leash is secured and the probe stick is moved toward the bone, mimicking normal caution when doing so. If the puppy ignores the intrusion, it is petted, given a food reward, and left alone to enjoy the bone for an additional minute. If the puppy attacks the probe stick, the bone is snatched away and the puppy timed-out. This test is not designed for adult dogs, wherein more precautions and safeguards may be needed to ensure safety for the trainer and the dog. Although the test is useful for detecting possessive aggression tendencies, failure of the puppy to show such behavior should not be taken to imply that under some set of circumstances it may not exhibit aggression while in possession of some prized item.

F. Impulse Control (Delay of Gratification)

During this test, the handler (owner or trainer) requires that a puppy stand quietly before receiving a treat. If the puppy already knows how to sit, the handler vocally prompts the puppy to sit, but, additionally, requires that it hold the sit position as the treat is moved toward its mouth. The puppy is required to take the treat gently. By standing on the puppy's leash, jumping and lunging are thwarted.

G. Ball Play

A puppy's willingness to chase and retrieve a tennis ball is assessed by first briefly causing the puppy to mouth or tug it. Interest can also be enhanced by bouncing the ball against a wall a couple of times before throwing it. The ball is rolled approximately 15 feet away. If the puppy runs after it and picks it up, it is encouraged vocally and with smooching and clapping to return with it, whereupon the puppy is rewarded with affection and tug before the ball is taken. The puppy is given three opportunities to fetch the ball and scored according to the best performance in terms of drive and cooperation, ideally chasing the ball enthusiastically and bringing it straight back without hesitation. In this test, the least favorable responses are to ignore the ball (deficient drive) or to run away with it (deficient cooperation), with the latter being preferable to the former. If the puppy fails to return or runs away with the ball, the handler should appropriately lure the puppy back or step on the leash or long line and take the ball away from the puppy. The puppy is returned to the original spot and allowed to mouth on the ball for a moment before the ball is thrown again. For smaller puppies, soft toys or smaller balls should be used.

H. Rag Play

A strip of cloth (e.g., burlap) is presented to the puppy and dangled or dragged back and forth for it to grab. If the puppy takes the rag, it is encouraged with praise to tug and hold on. Puppies are prompted to release the rag by offering them a treat. Another variation allows the puppy to keep the rag, and it is evaluated for its subsequent behavior. For example, the puppy runs off and shakes the rag, the puppy runs off and chews the rag, the puppy takes the rag and returns promptly to play more, or the puppy drops the rag. In addition, puppies are evaluated for their level of possessiveness when approached while in possession of the rag.

I. Separation Reaction

During the separation test, the puppy is usually placed into an unfamiliar room for 1 minute. A small room is ideal, but a larger room can also be used, as well. To prevent the puppy from wandering too much during isolation, it can be placed into a holding pen. A highly desirable treat or hollow rubber toy smeared inside with peanut butter is presented to the puppy. In the case of puppies showing a high level of separation reactivity, a piece of clothing with the owner's scent is

left with puppy. A third variation involves evaluating the puppies response to a mirror secured to the back of the door.

J. Reactivity and Problem Solving (Barrier Frustration)

A wire-mesh barrier is set up by stretching out a hinged holding pen, forming a crescent or V shape. Stakes are placed in the ground to support the barrier so that it cannot be knocked down if the puppy runs into it or jumps against it. The puppy is placed in the middle of the convex side of the barrier while the handler (owner) stands about 5 feet away on the opposite side. The scorer holds the puppy by a leash as the handler drops several small treats into a bowl on the ground. The handler should move about 2 feet back from the bowl and call the puppy, as the scorer releases the leash. In addition to scoring the sort of behavior exhibited by the puppy, the length of time that it takes to get around the barrier should be noted. If the puppy fails to solve the problem within 1 minute, the handler goes around the barrier to join the puppy and then demonstrates to the puppy how to get around the barrier. The handler places another small treat in the bowl and steps back from the barrier. If the puppy still fails to get around the barrier, it is taken around by the scorer, whereupon the puppy is received with affection and permitted to eat the food in the bowl. In addition to the specific items on the score sheet, the scorer should note whether the puppy goes to the handler first or the food, improvement occurring as the result of demonstration, and unusual behaviors.

K. Startle Reflex

A relatively strange area is usually selected for this test. Normally, the handler is located about 3 to 5 feet behind the puppy, and a seven-penny shaker can is dropped to the floor from waist high. The distance and size of the shaker can are determined by the puppy's relative sensitivity to auditory startle. Startle tests are typically reserved for puppies over 12 weeks of age. Any modifications of the basic test format should be noted on the test form. Puppies showing extreme reactions can be subsequently given a prepulse-inhibition test. In this case, the can is tapped with the flick of a finger as it is dropped. Any changes in the puppy's startle response are noted. After the startle event, the handler should encourage the puppy to come, receiving it with affection and petting, rewarding it with food, and tossing a ball. In addition to the auditory startle test, the puppy can be exposed to startle stimulation involving a visual component. For example, a spring-loaded umbrella can be opened at a perpendicular angle to the puppy from 6 to 8 feet away. Another variation involves dragging some novel rattling object (e.g., a toy wagon) near the puppy. Whenever possible bilateral tympanic temperature and heart rate measurements should be taken before and after exposure to novel and startling stimuli.

The following social cognition tests have been added to the original evaluation format:

L. Cognition (Expectancy)

The puppy is given 20 small treats from the right hand in the context of attention training (squeak, head turn, click). After a brief period, the handler presents a small biscuit held between the fingers of the left and right hands at approximately 12 to 16 inches from the puppy's nose. The hands are slowly separated so that the biscuit remains in the puppy's view, but is kept in the left hand. Since the puppy has learned to find the food treat in the right hand, it will tend to show a persistent tendency to follow the right hand, despite the presence of sensory information indicating an opposite fact (i.e., the treat is in the left hand) (see *Practical Example* in Volume 1, Chapter 7). The results (1 to 5) are measured by counting the number of trials the puppy requires to learn not to follow the right hand on two consecutive trials.

M. Cognition (Delayed Response)

The puppy is kept on leash at a doorway while the handler shows it a treat and places the treat in a small bowl situated behind one of three shoe boxes standing on their sides, thereby concealing the item from view. The

boxes are placed 5 to 7 feet apart. The middle box never contains food. The puppy is given several practice trials allowing it to run to the box where the food is hidden after waiting 1, 3, 5, 10, 15 seconds. The practice is continued until the puppy is able to able to find the food without error. Next, after the food treat is concealed while the puppy looks on, the door is closed and opened again after an increasing period (1, 3, 5, 10, 15 seconds), whereupon the puppy is released to locate the food item. The puppy is given five progressively longer trials, provided that it goes to correct box each time; otherwise, it is required to repeat the step until it succeeds. The results are evaluated in terms of the longest delay in which the puppy performed correct choices after five trials (see *Learning and Trainability* in Volume 1, Chapter 2).

N. Social Cognition (Passive Direction)

The arrangement is the same as just described, except the food item is concealed after the door is closed. The handler remains standing behind the shoe box where the food item is hidden. The puppy is released after 10 seconds from behind the door. The results are evaluated in terms of the number of correct choices in five trials.

O. Social Cognition (Active Direction)

An identical arrangement as the foregoing is set up, except the handler stands or sits on a chair behind the middle box. The puppy is given 10 trials of increasing difficulty (ranked 1 to 5) with respect to handler directional cuing: the handler makes a tapping action toward the correct box, the handler reaches and points at the correct box, the handler orients and points toward the correct box, the handler repeatedly turns and glances toward the box, or the handler steadily stares at the correct box. The puppy is given 10 trials during which it is allowed to advance to the next step after a minimum of two successful choices. After two consecutive incorrect choices, the puppy is returned to a previously successful step. The results are evaluated in terms of the number errors and the ranked difficulty of directional cuing.

In addition to the specific tests just outlined, impressions are recorded about the puppy's response to familiar and unfamiliar situations and objects. General impressions of fearfulness, activity levels, and excitability should be recorded (e.g., high, moderate, or low). Any behavior observed during testing that may help clarify the direction and significance of the test results should be noted and given appropriate consideration. In some cases, it can be useful to repeat tests on a weekly basis to observe changes resulting from maturation or training.

Significance and Interpretation

Several temperament tests have been devised and recommended to help place puppies in homes consistent with their behavioral needs (see *Temperament Testing* in Volume 1, Chapter 5). However, in recent years, the predictive value of such tests has fallen under significant doubt and controversy (see *Temperament Tests and Aggression* in Volume 2, Chapter 8). Although the results of such tests [e.g., restraining a puppy on its back, petting it along its topline, and lifting it off the ground (Campbell, 1972)] may be useful as general reactivity *indicators* (see Clark, 1994), they do not appear to be very useful as *predictors* or means for detecting stable *dominance* traits or propensity for dominance-related aggression (Beaudet, 1993).

The detection of stable traits and characteristics or interpreting the test scores as predictive indicators of adult behavior is not the primary purpose of the tests just described. The primary purpose of testing is to help define specific behavioral propensities and tendencies needful of training and therapy. Testing provides an objective picture of a puppy's behavioral potential (excesses and deficits) at the time of testing. In addition to identifying weaknesses needing attention, testing can also help to identify strengths to nurture and actualize further. Behavioral tendencies that persist despite dedicated training efforts and the influence of development may presage adult propensities.

Excesses associated with tests A and B are often misinterpreted as indicators of social dominance, appearing to confound opposi-

tional behavior with playful competitiveness. Unfortunately, the mischaracterization of social exuberance as an oppositional threat is not just an innocuous error, but an evaluation that has resulted in significant misunderstanding and maltreatment of puppies in training. A host of manhandling techniques has been developed to "break" such puppies to make them more submissive—a sad situation because most of these puppies are already submissive and in search of leadership; that is, their behavior is actively submissive—not dominant. Although exceptions certainly exist, most often puppies that use threats and overt aggression toward people do so as the result of mishandling and a failure to establish more competent and cooperative means to negotiate interactive conflicts and tensions. Although puppies affected by oppositional problems may also exhibit intrusive excesses, for the most part low scores on these tests are indicative of excitability, social enthusiasm, confidence, and playful competitiveness; such puppies may be characterized as social extraverts. In the context of Pavlov's typology (see *Experimental Neurosis* in Volume 1, Chapter 9), such extraverted puppies correspond to the sanguine or s type: friendly, socially responsive, focused, energetic, and highly sensitive to the effects of reward and less responsive to the effects of punishment. Puppies with low scores (1 and 2) are socially (and usually physically) healthy and outgoing (stable extravert), but needful of social limits and compliance training. In addition, play training may be very beneficial as a means to redirect their competitive enthusiasm into more constructive and cooperative outlets. At the other extreme, puppies exhibiting high scores (4 and 5) may be affected by significant social tendencies associated with introversion. Such puppies may show a generalized lack of behavioral output (inhibited) and may be socially reserved, passive, adverse to play, and highly sensitive to the effects of punishment and less responsive to the effects of reward (Gray, 1991). Puppies scoring 3s on tests A and B show a healthy balance between extraverted and introverted influences and, depending on future developmental, socialization, and training influences, may progressively move in the direction of increased introversion or extraversion (Figure D.1).

Under the influence of adverse developmental influences, extraverted puppies may become progressively unstable in the direction of Pavlov's choleric type (c type), being prone to show contact aversion (touch sensitivity and irritability), impulsive behavior, frustration and restraint intolerance, and nervous excitability. The c type is prone to panic-evoked aggression (rage) via the simultaneous and escalating arousal of fear and anger emotional systems. Unstable extraverts require highly structured reward-based training activities aimed at reducing interactive conflict and tension, together with management precautions designed to minimize provocative stimulation. The goal of training and management efforts is to reduce behavioral stress while increasing the dog's ability to gain a better state of security (comfort and safety) and trust. The c type tends to react to punishment rather than adjust to it, making physical punishment highly problematic in the case of such dogs. Mismanaged introverted puppies, on the other hand, may become progressively unstable and prone to develop melancholic tendencies (anxiety and depression) and behavior problems, e.g., social aversions, fears and phobias, and compulsive disorders. Whereas the c type tends to be affected by excessive excitability and impulsiveness (hyperactivity and stimulation seeking), the melancholic type(m type) tends to respond to the environment in a highly fearful, inhibited, or helpless manner. Under the influence of stability-enhancing training activities, introverted puppies can learn to cope more effectively with the environment and become progressively more confident and relaxed. In contrast, phlegmatic types (p types or stable introverts) tend to be passive, controlled, calm, and balanced with respect to their social and environmental interaction. Whereas s-type puppies may have trouble learning to wait and to delay gratification, such abilities come more naturally to p-type puppies. According to Pavlov (1994), all dogs can be grouped according to these four basic temperament types:

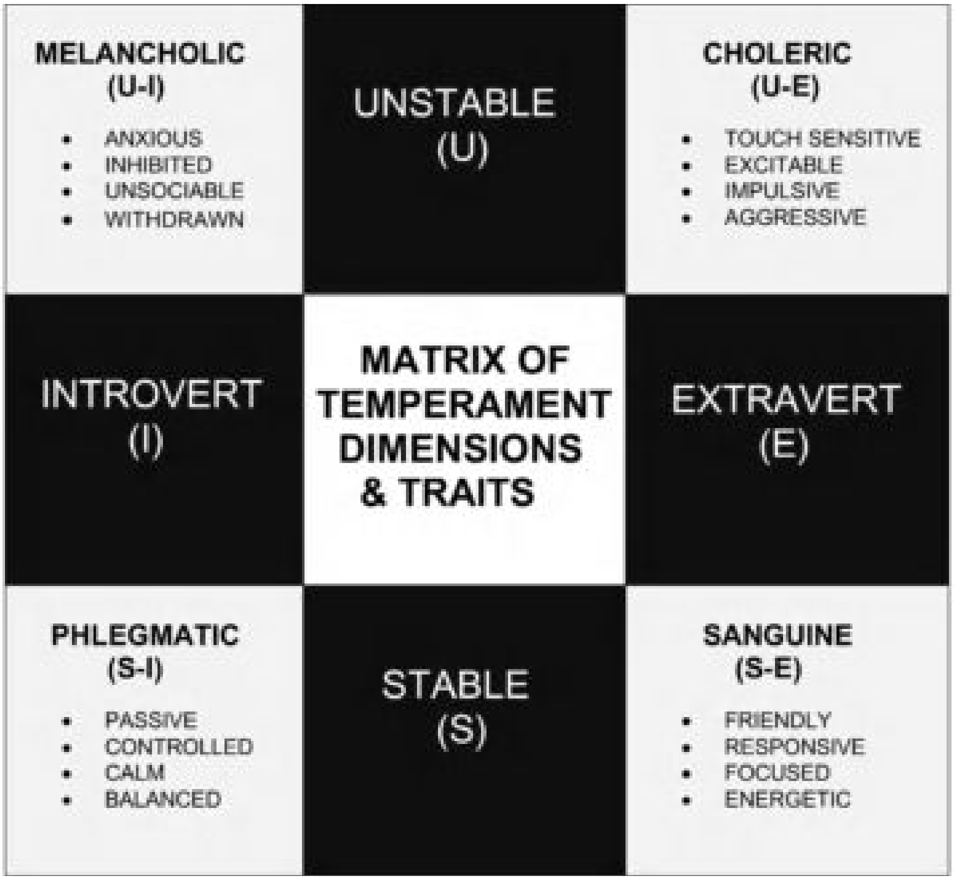

FIG. D.1. Matrix of temperament dimensions and traits. After Pavlov and Eysenck (see *Experimental Neurosis* in Volume 1, Chapter 9).

> Thus all our animals are divided into four definite groups: two extreme groups of excitable and inhibitable animals [choleric and melancholic] and two central groups of balanced but different animals: some very quiet [phlegmatic] and others extraordinarily lively [sanguine]. We have to consider this a precise fact. (216)

Whereas tests A and B give some indication of a puppy's social development in terms of relative extraversion or introversion, subsequent tests may serve to detect specific stabilizing or destabilizing influences. For example, high scores (1 and 2) on test C may indicate heightened touch sensitivity and excitability consistent with Pavlov's c type, whereas low scores (4 and 5) may indicate some degree of insecurity or social aversion, indicators consistent with Pavlov's m type. Puppies scoring 3 exhibit a fairly balanced response to contact, consistent with p type (stable introvert). Stable extraverts (s types) also show strong playful responses (mouth, paw, and jump up) while being handled. The cause of their behavior is the result of playful enthusiasm and poorly defined social limits—not contact aversion or impulse dysregulation. Differentiating biting and other excesses due to contact aversion versus playful enthusiasm is facilitated by the control tests (D1–D5). During control tests, unstable extraverts (c types) may become progressively aroused and resistant despite vocal reassurance and massage. Stable extraverts (sanguine), on the other hand, are typically more receptive to the calming effects of reassurance and massage. C types may become reactive and aggressive when rolled

on their side, whereas s types are more likely to accept such restraint without much resistance or struggle and rapidly calm down. S types are highly responsive to relaxation training, often falling rapidly into a deep relaxation response as massage proceeds. M types may struggle to get away or appear to resent physical restraint. P types typically show high scores (4 and 5) by passively accepting control and appearing to enjoy massage, but often enter into the relaxation response more slowly than s types.

Test E helps to differentiate these various temperament types further as well as providing an indicator of behavioral thresholds controlling aggression in response to appetitive loss or frustration (see *Anxiety, Frustration, and Aggression* in Volume 2, Chapter 8). Puppies getting low scores (1 and 2) in tests C and D1–5 that also show intense growling or snapping when approached while possessing a prized item may be at significant risk for serious problems unless significant and sustained behavioral efforts are undertaken. Well-socialized s and p types typically score 3 and 4 in the possessiveness test. M types may ignore the bone as the result of high levels of anxiety competing with appetitive arousal, a significant test for confirming such tendencies when other test scores appear to point in the direction instability (e.g., anxious, inhibited, unsociable, and withdrawn). Test F may have some value in detecting impulsive tendencies associated with hyperactivity, especially in the case of older puppies. Repeated jumping up and grabbing for the treat despite blocking (1), may reflect an inability to cope adaptively with frustration, a c-type trait. Stable extraverts (s type) tend to show high levels of excitement and enthusiasm but rapidly abandon impulsive efforts (2) to grab the treat and defer to physical restraint, whereas stable introverts (p type) show a more control and even appetitive response, together with a greater willingness to wait or sit when given a treat. In contrast, unstable introverts (m type) may refuse or avoid taking food.

Tests G and H can be particularly revealing. Puppies that show a natural aptitude for chasing and retrieving things are typically s types that are highly responsive to training for work and competition (see *Learning and Trainability* in Volume 1, Chapter 2). These tests can be further revealing by performing them under both familiar and unfamiliar circumstances. Choleric puppies may refuse to release the rag or stand guard over it with threats and snapping. P-type puppies may show a willingness to retrieve and tug, but typically lack real enthusiasm and sustained interest in the activity. M-type puppies may ignore the ball or halfheartedly chase it, but not pick it up or walk away after giving a brief chase. Unstable introverts (m type) may refuse to take a rag to play tug.

The separation-reaction test (I) helps to segregate excesses and deficits associated with attachment. Most puppies experience some degree of distress when separated in a strange situation. C-type puppies may exhibit sustained distress resulting from exaggerated reactions to loss and frustration. Such dogs may bark in a persistent and demanding way and scratch aggressively at doors. S-type puppies may also rebel at separation, but can be comforted with food or toys (e.g., peanut butter on the inside of a hollow rubber toy). While initially highly aroused, sanguine puppies may bark, but rapidly habituate to distress at separation and engage in diversionary activities. M-type puppies may be highly distressed at separation, reacting under the coactive influence of fear and anxiety, whereas p-type puppies may show a more restrained distress response when isolated for brief periods, but may become progressively distressed by longer separations. Whereas s types tend to bark more than whine, p types are more prone to whine than bark. Whereas s-type puppies appear to be responsive to the calming effects of food, p-type puppies appear to be more responsive to the presence of clothing and other items scented with the owner's odor.

The barrier test (J) is used to help evaluate a puppy's ability to cope with adverse emotional arousal (frustration) while solving a simple problem. Puppies that exhibit intense emotional reactivity and fail to solve the test within the allotted 1-minute period may be subject to significant stress. Again, the c type will tend to obtain low scores (1 and 2), whereas s and p types (exhibiting excitatory and inhibitory balance) will tend to obtain

higher scores. M-type puppies may stay close to the scorer and not attempt to solve the problem. The barrier test may help to identify learning and impulse-control problems. By measuring the length of time it takes the puppy to get around the barrier, the degree of interference can be given an objective measure. The benefits of behavior-therapy efforts may be estimated by comparing barrier test scores over time. Additional information may be obtained in the case of puppies that initially struggle or fail, but learn how to get around the barrier more quickly by observing the handler demonstrating how to do it. Such responsiveness may point to enhanced social learning abilities and sensitivity to human sources of information used to solve problems (Pongrácz et al., 2001).

The way a puppy responds to startling events may strongly affect its ability to learn and perform under aversive situations. Whereas choleric puppies appear to be adversely influenced by frustration, melancholic puppies are typically more vulnerable to startling sounds or movements. During the auditory startle test, c-type puppies may bark at the handler or even run at and grab the shaker can. P-type puppies typically show some evidence of startle, but quickly recover without evidence of lingering fearful arousal. S-type puppies may show significant startle (3) and recover, although some sound-movement-sensitive types may exhibit significant fear with retreat from the situation. Such otherwise stable puppies should receive intensified desensitization and habituation efforts to elevate the relevant threshold. As one might predict, unstable introverts may be significantly affected by the startle test, typically receiving high scores (4 and 5). In addition, to behavioral measures of emotional reactivity, heart rates should be taken before and after startling stimulation. Poststimulation heart rates should be taken 10 to 15 seconds after the event and again after 1 minute. Active and fearless puppies exhibiting low standing heart rates may be prone to develop offensive aggression problems (see *Autonomic Arousal, Heart Rate, Aggression* in Chapter 6), especially if they exhibit threatening behavior during contact-tolerance tests, physical control tests, or impulse-control (possessiveness) tests (see *Behavioral Thresholds and Aggression* in Volume 2, Chapter 8).

A prepulse-inhibition test may be useful in the case of puppies showing unusual responses to startle or other indicators of disorganizing reactivity. Normally, the presence of a comparatively weak stimulus presented just in advance of a startling acoustical stimulus serves to restrain the magnitude of the startle response. The absence of prepulse inhibition is a marker occurring in association with a variety of psychiatric disorders (Braff et al., 2001). Prepulse inhibition is conceptualized as performing a protective emotional function, on the one hand, and a cognitive processing function, on the other. With the occurrence of a startling (dangerous) event, it behooves the animal to stop what it is doing, collect as much relevant information as possible, and rapidly evaluate its significance. Without mechanisms such as prepulse inhibition, the animal may be emotionally overwhelmed by startling events and react blindly to them, perhaps endangering itself in the process. A lack of prepulse inhibition may reflect a gating deficiency affecting sensorimotor processing. Although published data are lacking in dogs, preliminary observations indicate that dogs generally exhibit a strong prepulse-inhibition effect. Future studies designed to evaluate prepulse inhibition in dogs exhibiting serious behavior problems may prove valuable in terms of understanding and treating certain severe canine behavioral disorders. In addition to providing an operational measure of cognitive function, such indicators may offer a neurological marker for confirming behavioral diagnostics and to evaluate treatment efficacy.

Delayed response testing provides another measure of cognitive function (Fox and Spencer, 1967). Delayed response and object permanence abilities operate under developmental constraints, with the dog's abilities appearing to improve with the maturation (Gagnon and Dore, 1994). Delayed response capacities depend on a complex coordination of emotional and cognitive functions that may be disrupted by stress and other disturbances affecting the frontal cortex and working memory (see *Cerebral Cortex* in Volume 1, Chapter 3). Deficiencies in delayed response capacity

may help to more accurately characterize impulse-control problems, perhaps providing a baseline from which to objectively evaluate the benefits of training and behavior therapy. Another useful indicator of cognitive function is the puppy's ability to adjust expectancies in accordance with prediction discrepancies. Adjusting behavioral output to fit sensory input and outcomes associated with instrumental activity is an important aspect of adaptive learning. When events and outcomes occur on a regular basis, the formation of prediction and control expectancies may exert a dominant influence over choices, even in the face of contrary sensory information. On the other hand, a predominance of irregular events and outcomes lacking reliability and orderliness (or lacking the ability to detect and organize such reliability and order) may cause the dog to depend more on direct sensory information to make decisions, with heightened behavioral stress (anxiety and frustration), hypervigilance, and scanning. Test L evaluates a puppy's ability to form a simple predictive-control expectancy and the rapidity with which the expectancy is changed in response to contrary sensory information and the discontinuation of the expected outcome.

Dogs showing compulsive tendencies and therapy-resistant reactive adjustments in association with social anxiety and ambivalent behavior appear to show a strong tendency to perseverate on the right hand after learning to expect food from there. The unproductive choice may continue on for many trials, despite the presence of obvious sensory information to the contrary and growing signs of distress on the dog's part. Such behavior gives support to the notion that habit formation takes place at choice points with the choice itself signifying that the action has undergone reinforcement. It is only through the inhibitory action of attention and impulse control that intelligent hesitation enables the dog to process choice points proactively and to choose well. Thus, the perseveration revealed by this cognitive test may provide information useful for assessing the fitness of executive functions. In addition, the test may reveal the presence of interfering social anxiety and reactive arousal impairing the dog's ability to adjust its behavior to the change. Dogs affected by this perseverant pattern may rapidly shift into a proactive selection mode when the test is performed by a family member or trusted person but may rapidly revert back to the previous pattern if startled or otherwise made uneasy.

The dog's ability to adapt to life with people is in large part mediated by social cognitive abilities. Normal puppies show an innate responsiveness to human directional cuing, especially pointing actions combined with gazing. The capacity of puppies to follow human pointing and gazing to find food and other attractive objects does not appear to depend on learning or developmental age, at least with respect to puppies 9 weeks of age or older (Hare et al., 2002). Interestingly, according to Hare and colleagues, the dog's ability to follow human pointing and gazing cues is superior to the abilities of the chimpanzee and the wolf to follow similar directional cues. The dog's ability to follow directional cues may be the result of linked social, emotional, and cognitive changes produced by domestication. According to Hare, the dog appears to have undergone a "process of phylogenetic enculturation" (1636) by which human and canine cognitive abilities have converged to make social bonding and cooperation possible. Tests M, N, and O provide useful information for assessing cognitive functions that may offer additional insight into the significance of other tests.

Deficits affecting a dog's ability to follow human directional cues or establish eye contact and sustained face gazing may reflect the presence of significant social anxiety and ambivalence, perhaps stemming from a persistent partial retraction of the social engagement system. In order to acquire social information of sufficient quality to promote autonomic attunement, the dog must orient and actively attend to the face in a relatively neutral and trusting way. Some dogs appear to show from an early age a tendency to treat eye contact and neutral facial expressions as threats. Some puppies may act on this negative bias by biting or snapping at the face instead of licking affectionately, which is the normal custom of most puppies. Even those puppies that are strongly motivated to compete and mouth on the hands will usually

shift from biting to kissing when permitted to get close to the face. Even dogs expressing high-reactive thresholds may show such problems at an early causing them to gradually lose their capacity to connect in a rewarding way with people. Although such dogs are usually not at risk of developing aggression problems, they may become increasingly insular and hyperactive or withdrawn. Puppies showing any of these signs should receive intensive therapy aimed at promoting friendly eye contact and social gazing. Target-arc training and play therapy appears to be particularly useful in such cases as a means for invigorating the social engagement system (see *Attention and Play Therapy* in Chapter 8).

Temperament test scores may reveal significant information about how a puppy is emotionally and cognitively organized and prepared to respond to social and environmental stimulation. Four temperament types have been described and characterized in terms of functional behavioral and motivational systems (see *Emotional Command Systems and Drive Theory* in Chapter 6). These types are differentiated by the way they respond to various provocative situations and stimuli. Balanced responses are characteristic of stable extraverts (s type) and stable introverts (p type), whereas unbalanced responses are typical of unstable extraverts (c type) and unstable introverts (m type). While s and p types appear to function under the complementary and balancing influences of the behavioral approach system (BAS) and the behavioral inhibition system (BIS), the instability associated with c and m types appears to stem from heightened BIS sensitivity to signals of punishment (threat and loss) and a reactive affinity with the fight/flight system (FFS) (see *Prediction and Control Expectancies* in Chapter 1). The FFS mediates the expression of escape and attack in response to aversive stimulation and frustration (nonreward).

The BAS and BIS work in relative harmony to mediate adaptation, with the former doing the steering and the latter doing the braking. The FFS is an emergency system associated with the reactive expression of unconditioned fear and anger. S- and p-type puppies and dogs are differentiated by the amount of influence exerted by the BAS and BIS. S types show an increased sensitivity to novelty and reward signals and operate under the dominant activating influence of the BAS (prone to approach), whereas p types are more sensitive to startle and reward signals associated with the avoidance of punishment and operate under the dominant inhibitory influence of the BIS (prone to hesitate). S and p types respond adaptively to signals of reward and loss of reward in the process of organizing behavior. S-type dogs tend to engage in modal strategies (searching, exploring, and competing) aimed at producing positive prediction error (surprise), whereas p-types tend to engage in modal strategies (e.g., hesitating, waiting, and deferring) aimed at avoiding negative prediction error (disappointment). In contrast, c and m types show a reactive sensitivity toward novelty and signals of punishment (risk and loss), predisposing them to reactive appetitive and emotional behavior resulting in opposite adaptations tending toward mania and exploitation, on the one hand, and anxious dysthymia and withdrawal, on the other. Further, whereas extreme c-types expressing low-aggression thresholds (trait aggression) are prone to respond in an invigorated fashion to signals of risk and loss under the influence frustration and anger (attack mode), m-types are prone to respond to risk and loss under the conflictive influence of anxiety or the invigoration of fear (escape mode), and may attack under the catastrophic influence of anger and fear (panic mode) if efforts to escape are blocked. Extreme c- and m-types appear to operate in close affinity with the FFS, recommending strongly against the use of punitive techniques in the control and management of puppies and dogs exhibiting such trait aggression or fear. C and m types require highly structured home environments and consistent reward-based training in order to stabilize them in the direction of the s and p type.

Temperament testing can be used most constructively in the context of assessing and guiding training and socialization activities. However, the results of such testing can easily produce significant potential harm when they are improperly generalized or used to forecast adult behavior. Although conventional temperament tests cannot reliably predict adult

propensities, they may inadvertently influence the eventual development of such problems via social placebo and self-fulfilling prophecy effects (see *Social Placebo* in Volume 2, Chapter 10). With the recognition that temperament tests have limited predictive value, except in the most extreme and obvious cases, breeders and trainers using such instruments should take great care not to overly alarm or plant the seeds of doubt and worry when interpreting and discussing the results of puppy temperament testing. Telling a prospective owner that his or her puppy is dominant or aggressive may adversely influence the way the owner treats the puppy, perhaps setting into motion a chain of events that gradually shapes a relationship based on misunderstanding, mistrust, and misguided training activities—all stemming from the influence of a careless opinion. Instead of being used to prognosticate and label the puppy or dwell on its negative potential, the results should be used to help the owner understand the puppy's behavior and to guide socialization and training efforts toward the actualization of the puppy's positive potential.

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